MECHANICAL ENGINEERING

July 1960

A SPECIAL REPORT

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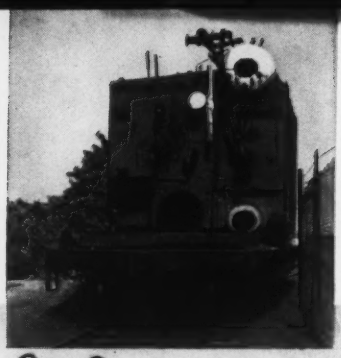
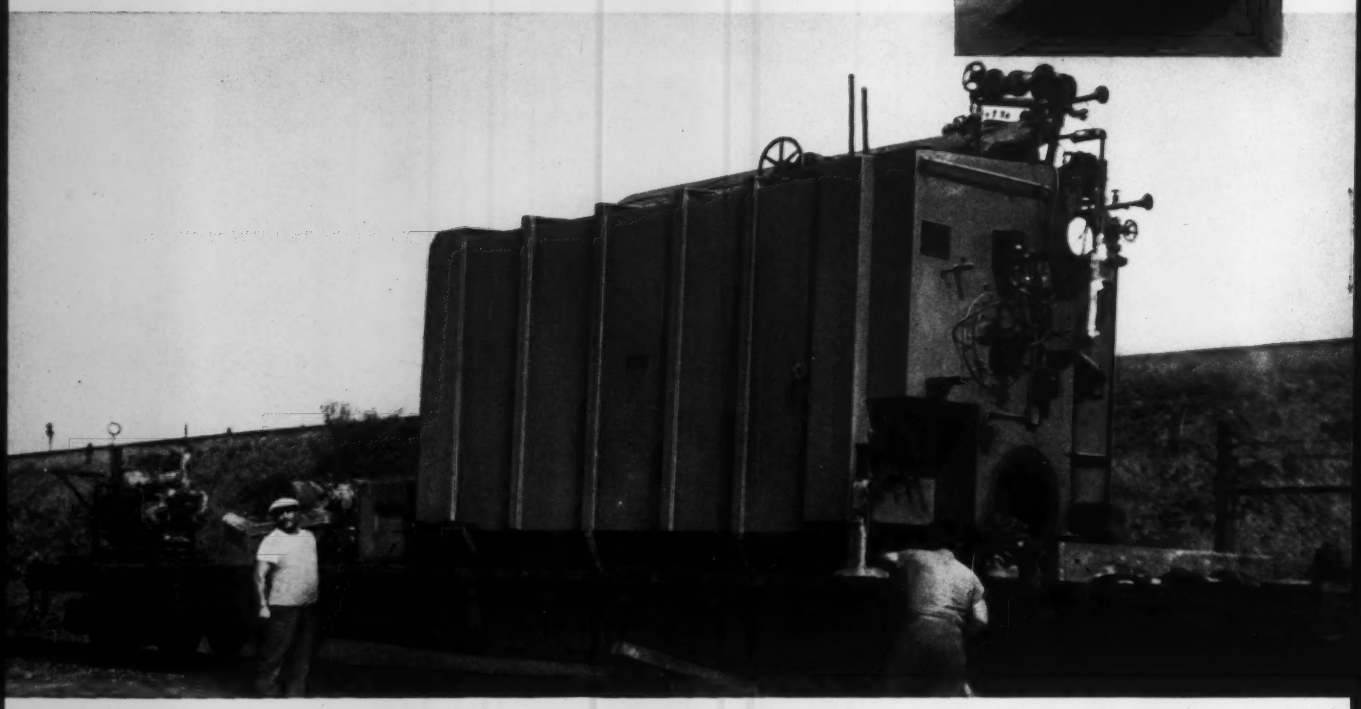
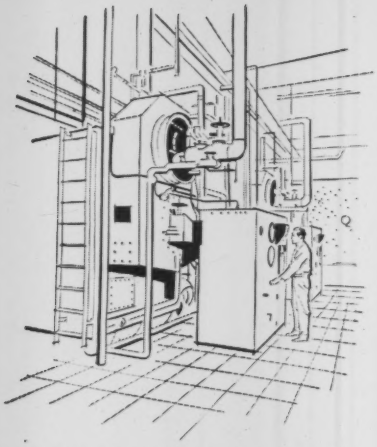
First B&W Shop-Assembled Boiler Ever Built Starts Life #2 South of The Border...







Number 1 of Nearly 1,000 Similar Units Meets Expanding Steam Requirements of Mexican Textile Firm

A decade ago, a major cleaning and laundering concern in Staten Island, N. Y., needed a dependable supply of steam for their massive laundering operation. In filling that need, B&W designed and delivered its first shop-assembled boiler. Operating at 165 psi and 358 F, this oil-fired package boiler served the company to perfection with 20,000 lb of clean, dry steam per hour.

The Staten Island firm had continuing success with this new departure in boiler design and in less than two years, the unit had paid for itself. The recent advent of the automatic washer and dryer, however, had so changed the laundry business that the firm now finds itself predominantly a dry-cleaning establishment. Having no further need for a unit as large as the FM-type boiler, the original owner recently sold it (at a good percentage of its original cost) to another B&W customer, the Textiles y Acabades Company of Mexico. Today, the boiler continues its fine record, generating heat and process steam for the Mexican textile firm.

Indicative of the *built-in* durability of B&W units, the "times and travels of FM-1" are further evidence in action of dependable steam generation by B&W. Whatever *your* steam requirement . . . whatever your most economical fuel, B&W has the boiler best suited to your application. Your local B&W representative has all the facts on your area. Call him soon. The Babcock & Wilcox Company, Boiler Division, Barberton, Ohio.

B&W — THE NATION'S LEADING MANUFACTURER OF INDUSTRIAL BOILERS

G-980-1B

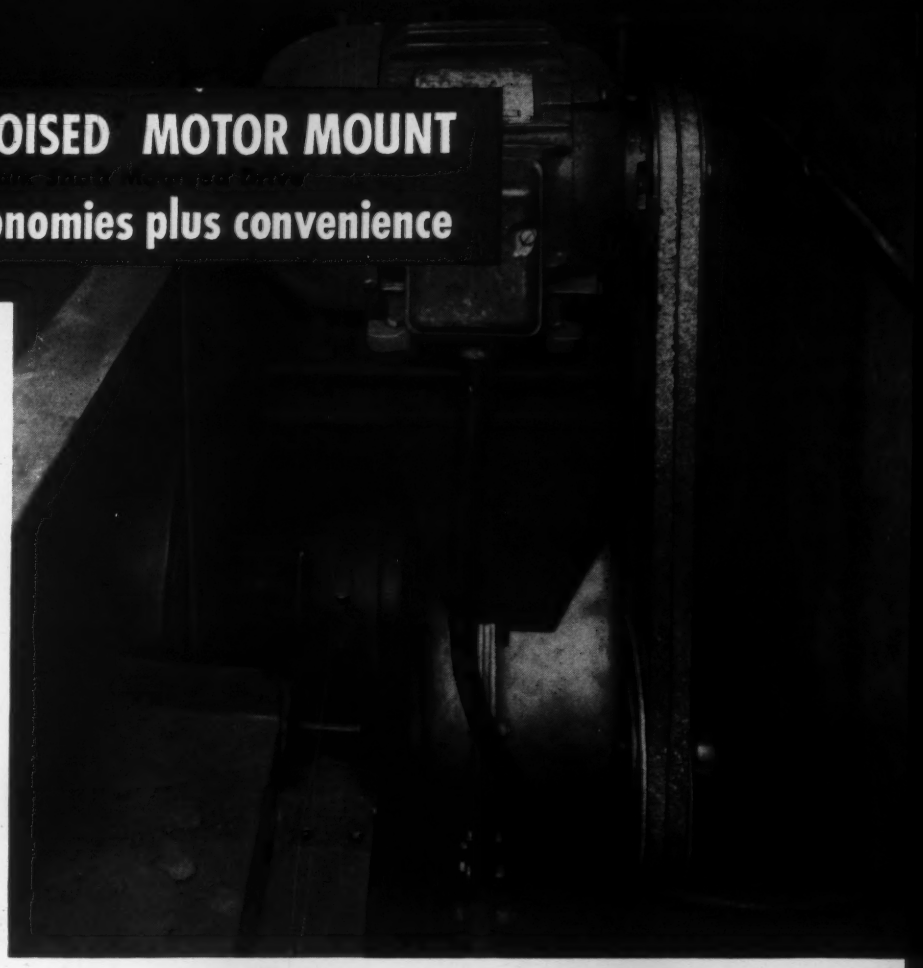
B&W

THE BABCOCK & WILCOX COMPANY

BOILER DIVISION

NEW FALK EQUI-POISED MOTOR MOUNT

gives unequaled economies plus convenience

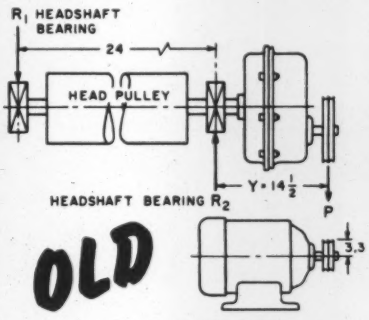


HOW A FALK EQUI-POISED MOTOR MOUNT REDUCES BEARING LOADS ON A DRIVEN MACHINE

GIVEN: Motor—15 hp, 1750 rpm, Frame 284U, Weight—320 lb.
Sheave diameters—6.6/9.4
Driven machine—belt conveyor with 24″ center distance between headshaft bearings.

NOTE: Weights of 307J24 Shaft Mounted Drive, sheaves, and V-belts are eliminated from calculations because they remain constant; do not affect the comparison.

WITHOUT FALK MOTOR MOUNT



OLD

Torque at motor shaft = $\frac{63{,}025 \times 15 \text{ hp}}{1750 \text{ rpm}}$ = 540 lb-in.

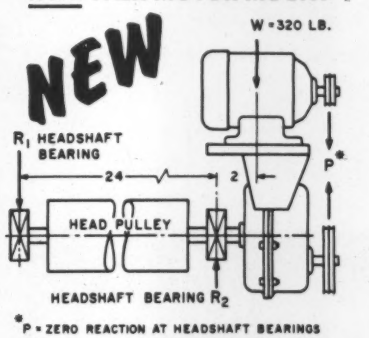
Belt pull (P) = $\frac{540 \text{ lb-in.} \times 1.5 \text{ Load Connection Factor}}{3.3''}$ = 246 lb

$R_2 = \frac{246 \text{ lb} \times (24'' + 14.5'')}{24''}$ = 395 lb

$R_1 = \frac{246 \text{ lb} \times 14.5''}{24''}$ = 149 lb

(Check: 395 lb—149 lb=246 lb)

WITH FALK MOTOR MOUNT



*P = ZERO REACTION AT HEADSHAFT BEARINGS

V-belt pull has zero reaction on headshaft bearings. Therefore—

$R_2 = \frac{320 \text{ lb} \times (24'' + 2'')}{24''}$ = 347 lb

$R_1 = \frac{320 \text{ lb} \times 2''}{24''}$ = 27 lb

(Check: 347 lb—27 lb=320 lb)

Falk's new EQUI-POISED* Motor Mount is a rigid, all-steel weldment, pre-drilled for bolting standard NEMA foot-mounted motor (1/2 to 30 hp) directly to the steel frame of Falk Shaft Mounted, Flange Mounted and Screw Conveyor Drives. With it, motor can be mounted in almost any position around perimeter of reducer.

(*Balancing of forces.)

Substantial Savings for You

It saves engineering time required to design special motor bases and foundations...saves cost of labor and materials required to build special motor foundations...and saves on equipment costs by using a quality stock component. Further, its quick installation and easy maintenance mean added cost savings. The Motor Mount is a space saver, too. Where restricted space is a factor, ability to mount motor in any of several positions is an important convenience...For information on range of sizes, dimensions, etc., contact your Falk Representative or Distributor—or write direct for Bulletin 7100.

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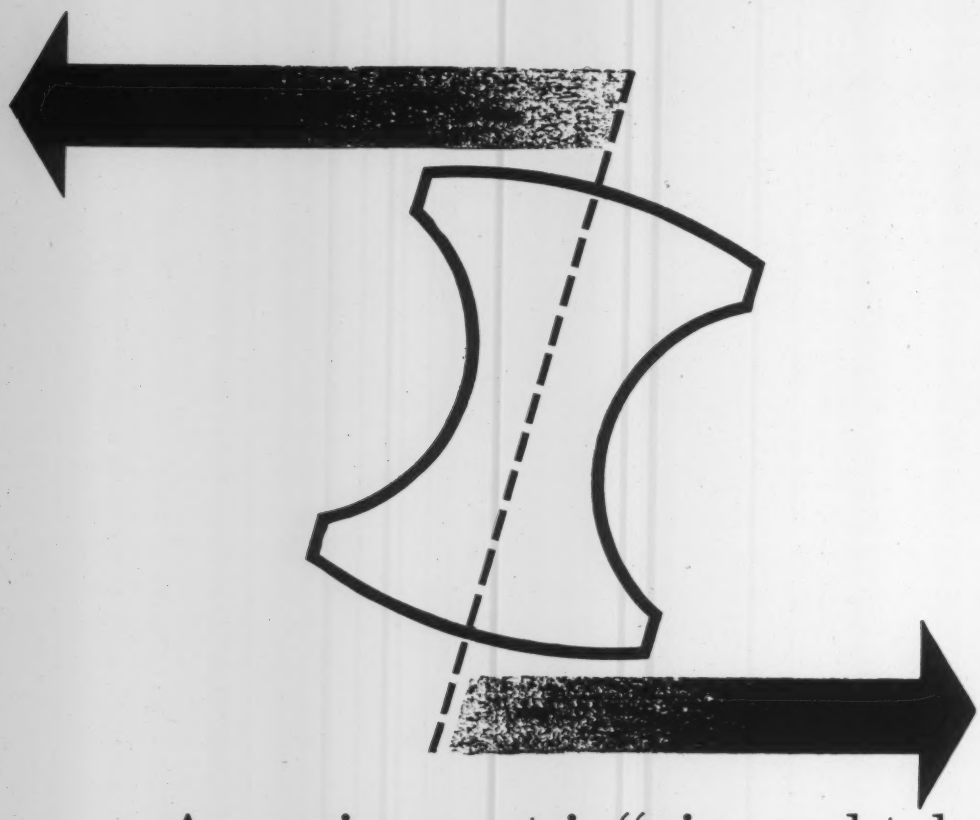

An assignment in "give and take"... for Lukens Application Research.

Researching the steel that best fits the job is a matter you can safely trust to Lukens Application Engineers . . . whether your problem is metal expansivity, cryogenics, abrasion, structural stress or the complexities of corrosion. A recent and typical assignment was to determine the most efficient material on which to cradle the bearing members of a bridge. These mechanisms provide the "give" that keeps a bridge structurally sound. Since corrosion-resistance was a major goal, stainless steel seemed well-suited—but costly. Lukens, with its broad fund of practical metallurgical knowledge, suggested—then thoroughly tested—the less expensive stainless-*clad* steel. The success of this engineered combination of clad and backing steel has since been borne out by a host of clad steel bearing plate applications.

If you have an assignment in metals application, let it be our assignment too. Also contact us for Bridge Bearing Plate Bulletin. Write Manager, Application Engineering, Services Building, Lukens Steel Company, Coatesville, Pennsylvania. Address Dept. G-70.

HELPING INDUSTRY CHOOSE STEELS THAT FIT THE JOB

LUKENS STEEL

MECHANICAL ENGINEERING

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THE COVER

An arc-jet rocket engine derives thrust from gas heated by passing through an electric arc. The heated gas expands supersonically through a rocket nozzle. Avco's Research and Advanced Development Division, Wilmington, Mass., tested this small arc jet in a near vacuum, using helium as a working fluid. Ultimate purpose: To keep a satellite on station, or to shift its orbital altitude. The 3/4-lb thrust, over the 47 hours of the test, would have increased the velocity of a 1000-lb orbiting space vehicle by some 4000 fps.

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Better know your law. If you lack state registration as a professional engineer, you may be denied payment for your engineering. It has happened. Author Tunis is a lawyer as well as an engineer.

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Safe Conveyers.....**J. C. Webb**

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B&W's comprehensive quality control procedures help provide . . .

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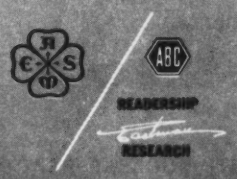

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shop-assembled to 120,000 lb/hr capacity

Designed for Industry by

C-E shop-assembled boilers are available for a wide range of industrial, commercial and institutional applications. They are produced by the same C-E engineers who design the world's biggest and most efficient utility boilers—with capacities to 4,000,000 lb/hr and pressures to 5,000 psi. For the most economical solution to *your* steam or high-temperature water problems, write to C-E, outlining your requirements.

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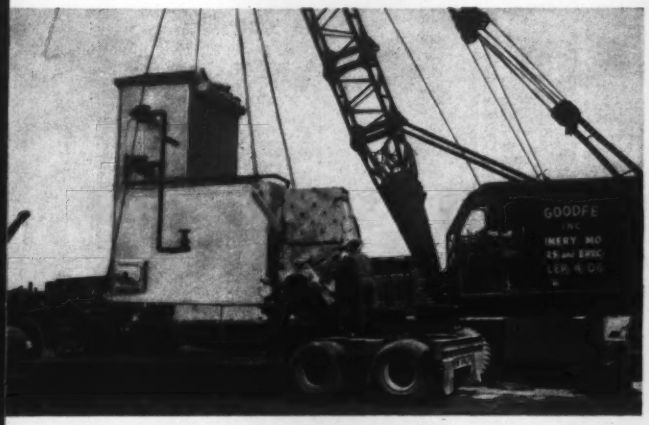
To 90,000 lb/hr . . . Type VP—A compact, economical, natural circulation, *package* boiler for the majority of industrial requirements. Steam capacities from 4,000 to 90,000 lb/hr; pressures to 700 psi; temperatures to 750 F. Most sizes shipped complete with firing equipment for oil or gas, setting and forced draft fan arrangement.

To 120,000 lb/hr . . . Type PCC—Shop-assembled *controlled circulation* boiler providing high output and high temperatures in a compact, high-performance unit. Capacities—80,000 to 120,000 lb/hr; pressures to 1,000 psi; temperatures to 900 F. Designed for minimum installation, operation and maintenance costs.



To 50,000,000 Btu/hr . . . Type HCC—High-temperature water boiler, shop-assembled, widely used for large-scale, economical heating of commercial and industrial installations—including many military air bases. Controlled circulation, pressurized oil or gas-fired from 10 to 50 million Btu; coal-fired to 40 million Btu. Field-assembled units to 300 million Btu.

To 50,000 lb/hr . . . Type WCC—Shop-assembled. Utilizes waste heat from open hearths or chemical processes. C-E controlled circulation design obtains big boiler performance from space-saving units. Capacities to 50,000 lb/hr—and up, depending on waste heat conditions—with pressures to 450 psi and temperatures to 750 F. Capacities of field-assembled units are virtually unlimited.

UTILITY-BOILER ENGINEERS

Write for catalogs—

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C-E CONTROLLED CIRCULATION PACKAGE BOILER, TYPE PCC

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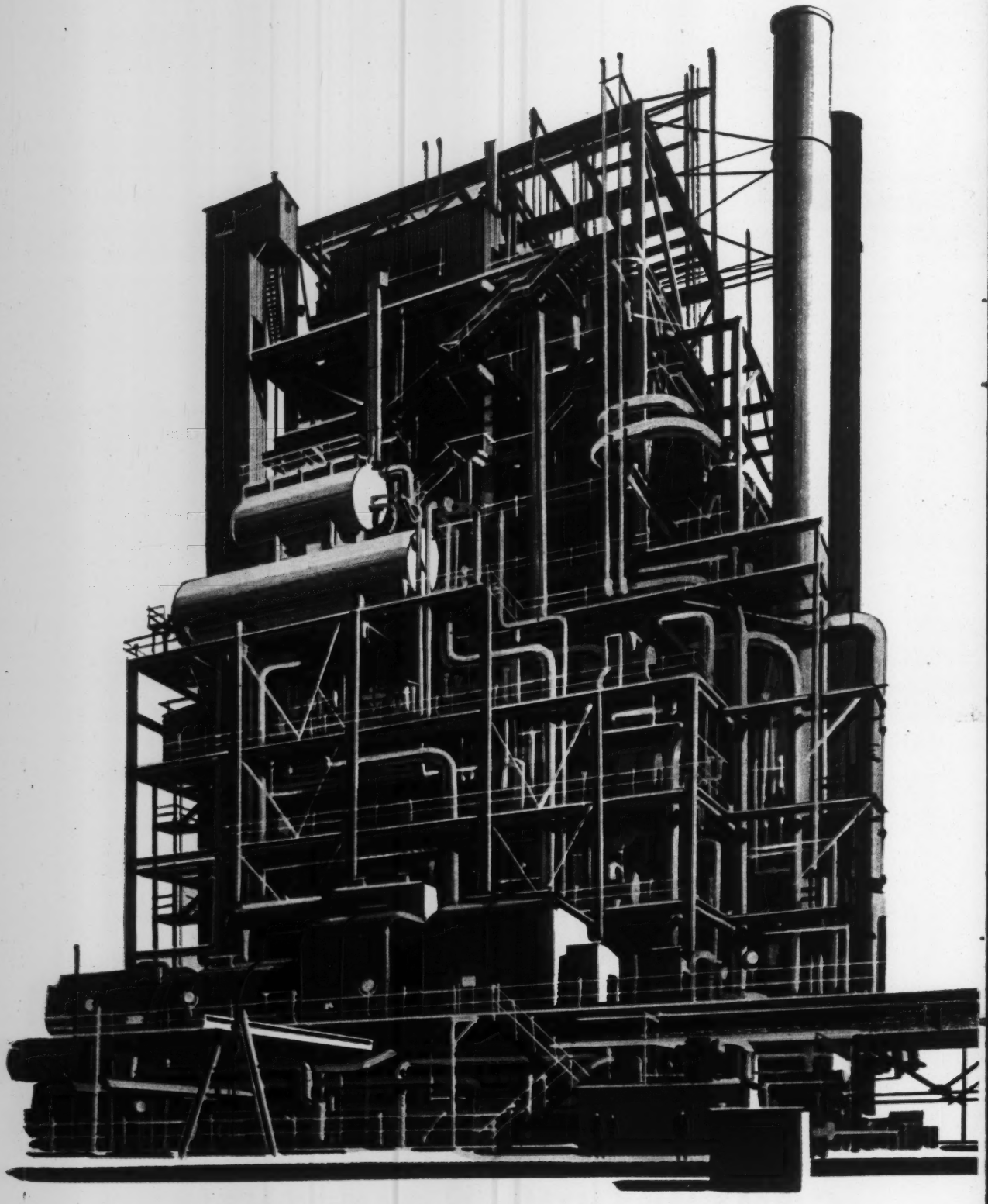

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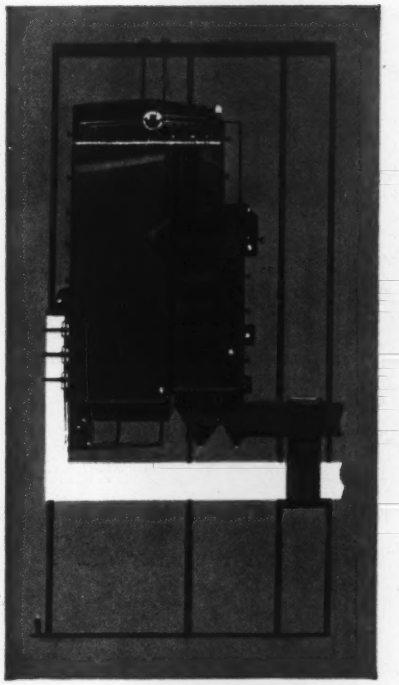
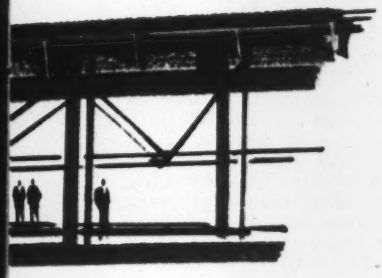


A word about steam generators

In this age of miracles some forthright words have been mislaid.

One is *thoroughness.*

Thoroughness is as much a product of our company as steam generators. By *thoroughness* we mean "careful attention to detail"—not some of the time but all of the time.



What does this mean to you? It means you save money on operations, keep your maintenance staff to a safe minimum, and prevent costly power interruptions.

Foster Wheeler Corporation, 666 Fifth Avenue, New York 19, N.Y.

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STEAM TURBINE-GENERATORS

By N. K. Halsteen, Project Engineer, Brown Boveri Corp.

BROWN BOVERI

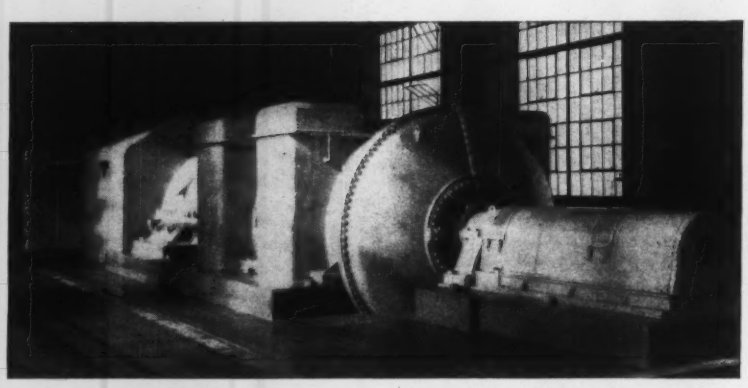
In 1901, Brown Boveri built the first steam turbine installed on the European continent. This turbine was also the world's largest. Since then, the company has made many basic contributions to turbine design and has built more than 5300 steam turbines for generating electric power and for driving blowers and compressors.

Brown Boveri steam turbine-generators include these types and sizes:

Condensing units offer highest efficiency, lowest steam consumption. All ASME Preferred Standard sizes. Single-shaft units to 350 mw. Cross-compound units to 500 mw and up.

Back-pressure units are rated at 500 to 30,000 kw and supply exhaust steam at 20 to 350 psia for low-pressure condensing units or for process.

Extraction-condensing units are rated at 1000 to 100,000 kw. Extraction steam at 7 to 15 psia is used for process and for heating water in municipal heating systems.



A Brown Boveri 30/33 mw Preferred Standard unit at Greenwood Mills, S. C.

Sectional rotors

Brown Boveri turbine rotors are made of forged sections welded together at the rims. This construction offers advantages over one-piece rotors: The relatively small size of each section ensures a more uniform forging and allows more thorough inspection. Sections with flaws are rejected and replaced virtually eliminating patching often required to salvage large one-piece forgings.

Asymmetries are cancelled out by the random positioning of adjacent sections. The low weight of a hollow, sectional rotor provides fast warm-up and rapid, uniform heat distribution in service. The sectional design eliminates axial stresses. Completed rotors are given ultrasonic tests and stress-relieving heat treatment. *No explosions or other serious failures have ever been experienced with Brown Boveri sectional rotors.*

Sections of a steam turbine rotor before welding. Welding is done automatically by an inert-gas process.

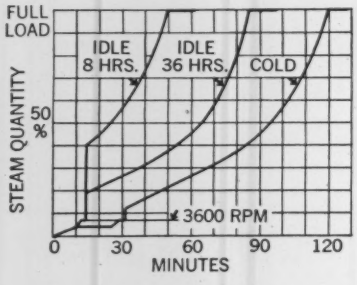
Hydraulic governing system

The Brown Boveri all-hydraulic, governing system uses no mechanical links and thus eliminates joint play or thermal expansion of links which may cause "hunting." Synchronization is quick, simple. On high-temperature reheat units, the governing system is separate from the lubricating oil system and uses a non-combustible fluid.

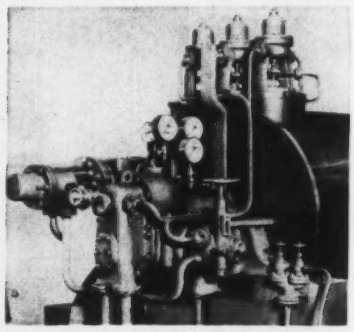
Fast start-up, flexible loading

The low weight of the rotor, lightweight casings and special flange-heating systems reduce temperature differences in the machine to a minimum . . . allowing fast and cold starts, fast changes in load and fast shut-downs without dangerous expansion differentials. Close radial tolerances can be maintained.

These advantages, together with simple synchronizing, are particularly useful where frequent start-ups are required . . . as for peaking.



Starting schedules for a large multi-cylinder reheat turbine . . . illustrating how quickly temperatures in the machine are equalized.



Brown Boveri linkage-free pressure oil governing system. Turbine may also be started and shut down with a single handwheel.

Service

Brown Boveri maintains installation crews and service shops in the U. S. and Canada . . . also working agreements with Todd Shipyard Corp. and National Electric Coil Co. whose shops can rebuild or repair the largest turbines and generators now in use and who have an outstanding record for fast, efficient service.

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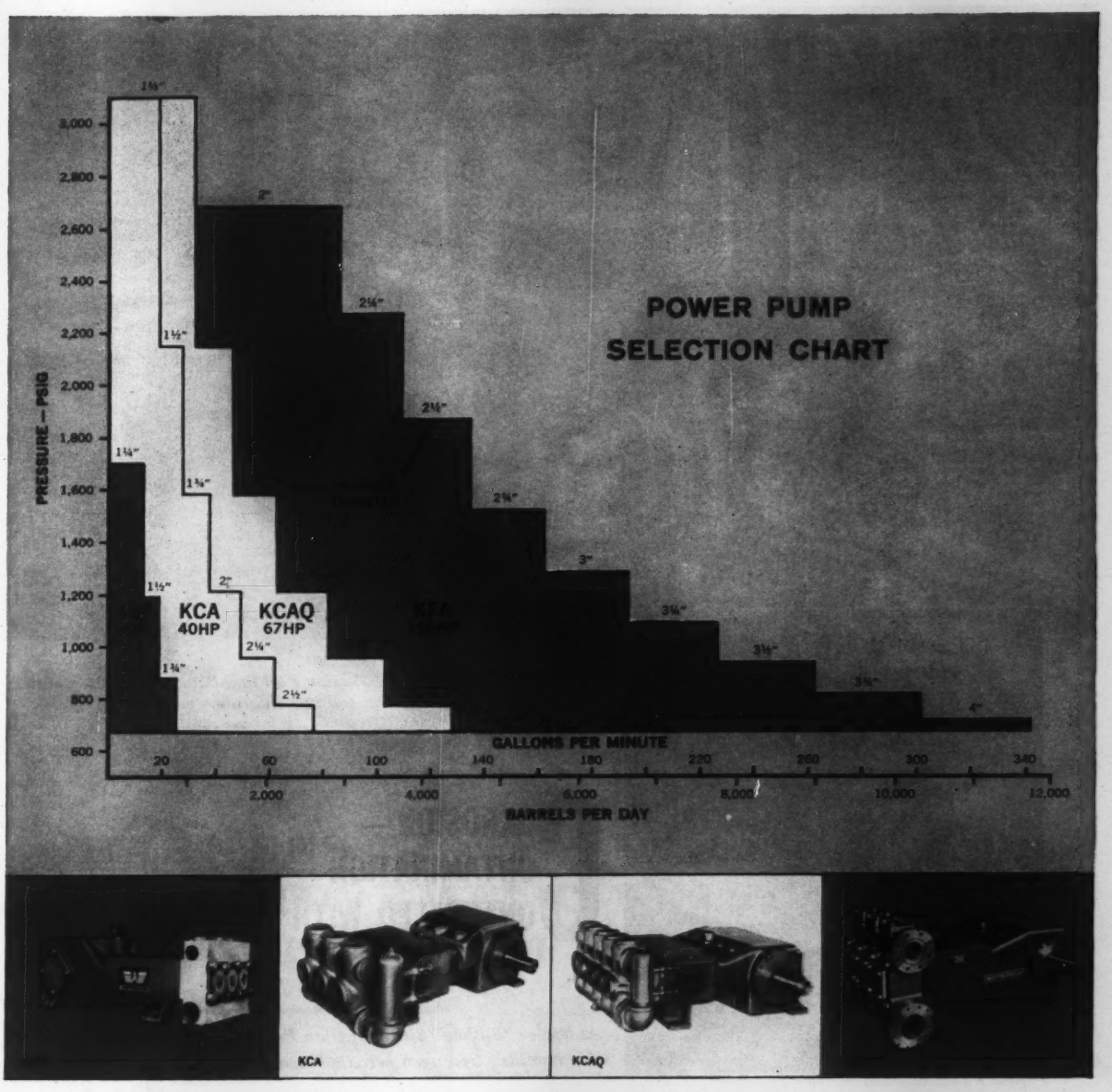


NEW PUMPS EXTEND RATINGS

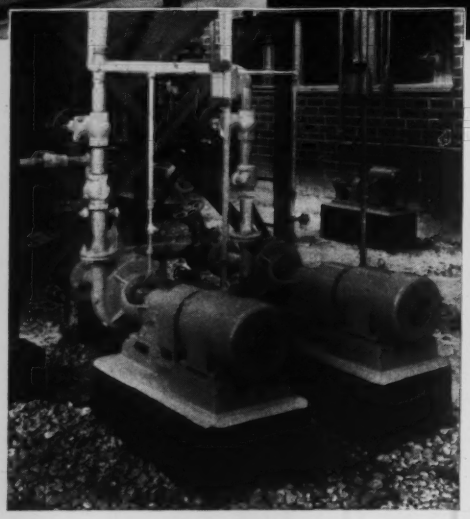
...to make Worthington your lowest cost high-pressure pump

This is the first public announcement of two new Worthington high pressure, reciprocating pumps. With nominal ratings of 15 and 150 hp, they complement existing pump lines rated at 40 and 67 hp. All are horizontal designs which save you up to 53% on initial cost.

These four pumps—each available in several interchangeable plunger sizes—allow you to buy the most economical amount of pump for your particular application. Should you require pumps of more than one rating, you save money on spares because many parts are interchangeable in the Worthington line.

Some of the applications where Worthington high pressure pumps can save you money include hydraulic presses and shears, steel mill roll balance, die casting, boiler feed service, descaling, cleaning and washing, fog spraying, hydrostatic testing, and chemical processing. For more information write Worthington Corporation, Section 32-8B, Oil City, Pa.

WORTHINGTON



Above — "Buffalo" Single Suction Full Ball Bearing Pumps, stainless steel construction, handling sodium chlorate

CORROSION— CONTAMINATION CONTROLLED WITH "BUFFALO" PUMPS

At left — "Buffalo" Single Suction Pumps of stainless steel construction handling hydrogen peroxide bleach.

Using a wide range of materials of construction, "Buffalo" offers a line of pumps capable of handling your toughest liquid moving job. You can order a "Buffalo" pump made of Hastelloy B or C, nickel, bronze, lead, stainless, in fact just about any material that can be cast and machined.

Properly applied, these pumps can cut your liquid moving costs, reduce down-time due to pump failure and improve quality control where contamination may be a factor.

For your tough liquid moving jobs, phone or write your "Buffalo" Engineering Representative or write direct. Tell us the liquid you want to pump and we will be pleased to suggest the best material of construction for the job.

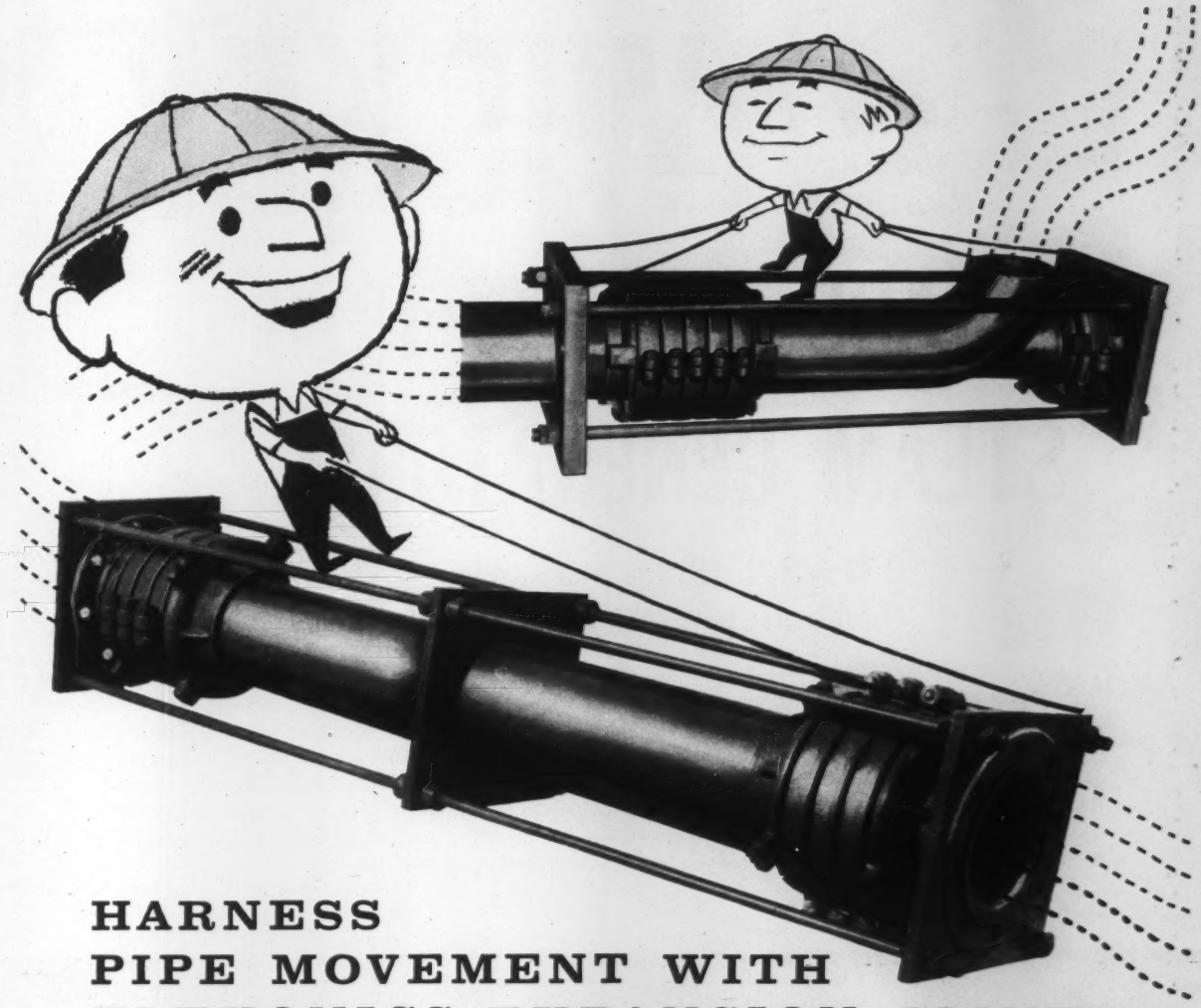
"Buffalo" PUMPS

BUFFALO PUMPS DIVISION OF BUFFALO FORGE CO.

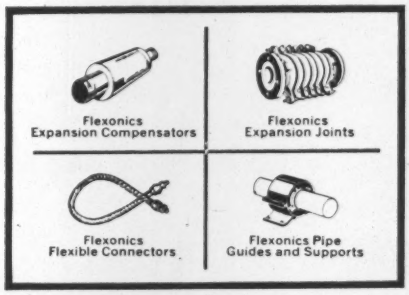
148 Mortimer Street Buffalo, N.Y.

Canada Pumps Ltd., Kitchener, Ont. Sales Representatives in all Principal Cities

A BETTER CENTRIFUGAL PUMP FOR EVERY LIQUID



HARNESS PIPE MOVEMENT WITH FLEXONICS EXPANSION JOINTS

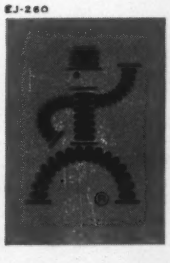


Here's how to keep pipe movement under control! **Flexonics Self-Restrained Dual Expansion Joints** can absorb large amounts of lateral movement while keeping anchor forces at a minimum. **Flexonics Pressure Balanced Expansion Joints** replace main anchoring at changes in piping direction, by restraining the end thrust.

These are just two of the standard and special types of expansion joints engineered and built by Flexonics to help you harness pipe movement. **Check and mail the coupon today for complete information.**

EJMA **Member Expansion Joint Manufacturers Association**

EJ-260



Flexonics corporation

In Canada: Flexonics Corporation of Canada, Ltd., Brampton, Ont.

EXPANSION JOINTS · METAL HOSE · SYNTHETIC HOSE · BELLOWS · AERO/SPACE COMPONENTS

SUBSIDIARY OF CALUMET & HECLA, INC.

ATTACH TO YOUR LETTERHEAD—MAIL TODAY!

Flexonics Corporation
1305 South Third Avenue
Maywood, Illinois

Please rush me complete information on

- ☐ Expansion Joints
- ☐ Expansion Compensators
- ☐ Flexible Connectors
- ☐ Pipe Guides and Supports

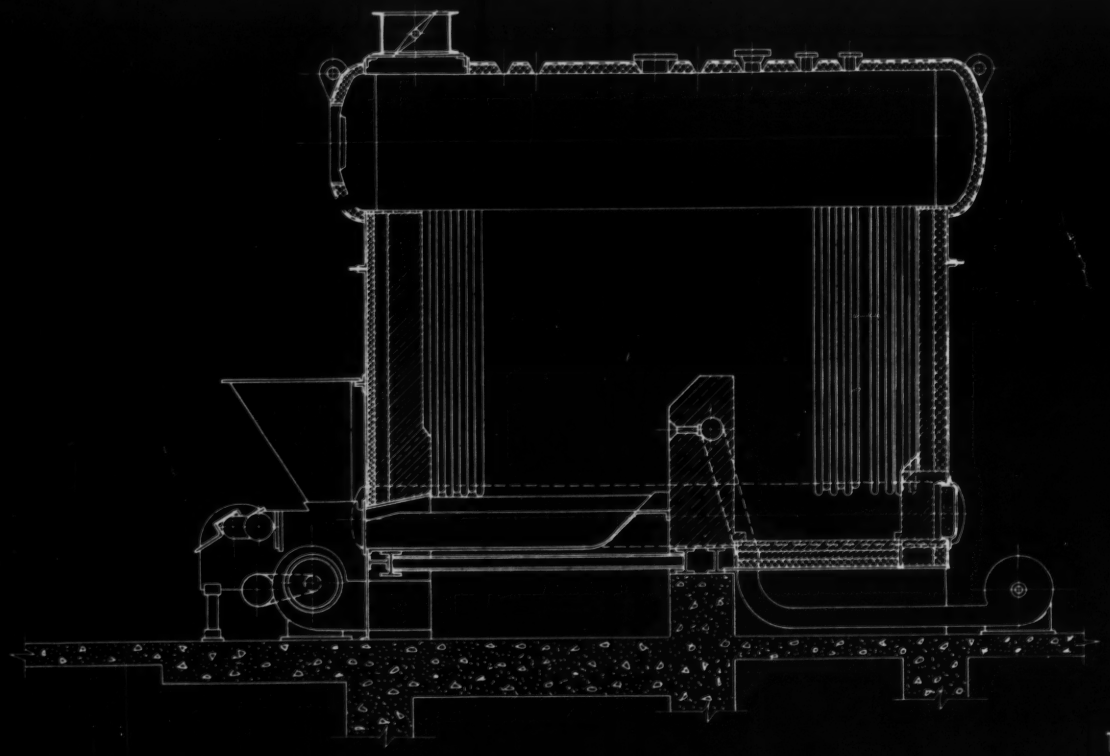
you can take full advantage of the fuel situation with

WICKES

PACKAGE STOKER-FIRED STEAM GENERATORS

Designed and built to WICKES recognized standard of excellence, engineered to WICKES high standard of efficiency

These stoker-fired WICKES generators are compact, package water tube boilers, custom-engineered to your exact steam generating requirements. Semi-automatic in operation and convertible from stoker-fired to either gas or oil fired, these WICKES generators are built to the highest standards of workmanship to give you the same efficiency of operation that you have come to expect from all WICKES-built boilers. They are built in a variety of designs to meet size, space and fuel conditions. For complete information on these WICKES stoker-fired units as well as the complete line of WICKES water tube steam generators, ask the WICKES sales representative nearest you to call . . . offices in principal cities*.



TYPE A

TYPE S-3

TYPE A

WICKES

BOILER CO., SAGINAW 13, MICHIGAN

RECOGNIZED QUALITY SINCE 1854

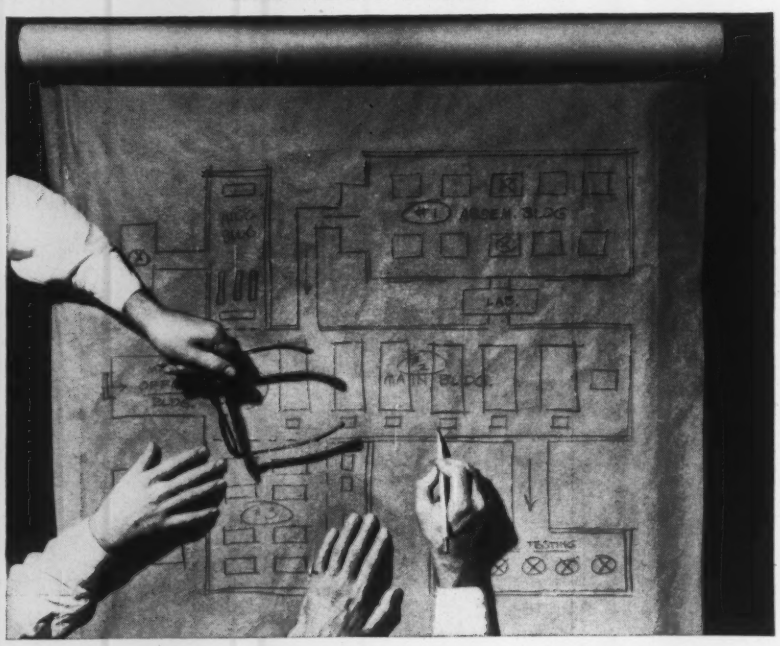
*SALES OFFICES: Atlanta • Boston • Charlotte, N. C. • Chicago • Cleveland Dallas • Denver • Detroit • Houston • Indianapolis • Los Angeles • Memphis Milwaukee • New Orleans • New York City • Philadelphia • Portland, Ore. Rochester, N. Y. • Saginaw • San Francisco • Seattle, Wash. • Springfield, Ill. • Tulsa

DIVISION OF THE WICKES CORPORATION

Some Ideas

for your file of practical information on drafting and reproduction... from

KEUFFEL & ESSER CO.



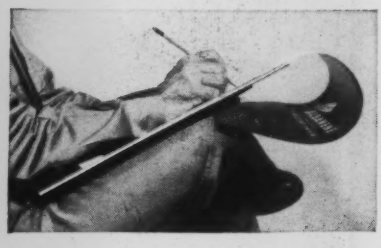
Papers, in their special way, are as different as people . . . and choosing the best paper for a specific job can be as difficult as choosing the best *person* for the job. Here at K&E, we try to do the work for you, by painstakingly determining precisely the characteristics required, then refining them to the point of excellence. Here are some good examples:

A New Type Of Typing Paper

Translucent typewriter papers are very popular of late for typed originals from which numerous copies must be made. The savings are considerable when you use translucent originals through diazo reproduction—savings up to 80% in many cases. But most translucent papers used today stand erasure very poorly. Recognizing the inevitability of human error, K&E has perfected a better translucent typewriter paper called TYPEMASTER® (193)—the perfect answer for those whose typing is less than perfect. TYPEMASTER's completely new, *engineered* surface affords outstanding erasability. A thin, unusually tough coating, it readily catches and holds the typewritten image, yet resists penetration of the ink into the paper fibers . . . and therein lies the secret of good erasability. A number of skeptics who tested the new TYPEMASTER sheets have now discarded all others. Skeptical or not – may we suggest you try it.

Tracing Pads "To Travel"

Brilliant ideas often occur at random moments. For that reason, engineers on the move usually keep a tracing pad handy. But pads with soft, chipboard backing are of little use without a desk under them. That's why all K&E tracing pads are



backed with sturdy bookbinder's board – the same tough board found in any high-priced, permanently-bound library volume. Wherever you are you're assured desk-firm support with a K&E pad. Another plus – the sheets are bound in by a gummed edge for neat and easy removal. Available in a wide variety of grid patterns and sizes, with plain or imprinted sheets (standard headings), K&E book-bound, gummed-edge tracing pads are perfect workmates for the "portable" professional.

Now You Can "Talk" In Triplicate

Although low-priced canary tissue enjoys wide usage as a so-called "talking paper", we've heard many complaints about its inability to reproduce well in standard copying machines. With this in mind, we present K&E's newest LIGHTWEIGHT SKETCHING TISSUE (185) – designed specifically as a *reproducible* "talking paper." This tissue is ideal for preliminary sketching when you want sharp reproductions from a standard diazo, blueprint or office copying machines. It's a pure bleached sulphate with just enough yellow tint added to afford good contrast for pencil, charcoal or crayon. You'll find K&E LIGHTWEIGHT SKETCHING TISSUE well worth any small price difference.

The Most Pampered Natural Paper In America

For the greatest transparency, the overwhelming choice is K&E ALBANENE® prepared tracing paper. But for ability to stand a lot of abuse on the drawing board and in subsequent processing and handling —many companies prefer to sacrifice some transparency and use a *natural* tracing paper. Here we recommend a truly remarkable K&E product—BANKNOTE T.M. (174L). This thin, flexible, 100% rag tracing paper will weather a double share of abuse. You can actually crumple a sheet of K&E BANKNOTE up into a tight ball . . . then smooth it out to find it almost as good as new for reproduction purposes! The paper makers who produce BANKNOTE for K&E proudly refer to it as America's most pampered tracing paper. No other paper we know receives the same care and attention . . . from initial inspection of the textile bales, through every step of processing, to final shipment. With K&E BANKNOTE, papermaking skills come into play as with no other paper made on this side of the Atlantic – from use of a paper machine that runs a "top jacket" (one of the few still employed), through the artful "wet packing" process, to careful air-drying, super calendering, and rewinding. The result is a sheet of unsurpassed mellowness, yet with unusual stamina and workability.

You can test this quartet of fine papers at your local K&E dealer's . . . or use the coupon below to get samples for private perusal. Do it *today* . . . there's a world of better work at stake.

KEUFFEL & ESSER CO., Dept. ME-7, Hoboken, N. J.

Please send me samples and further information on the following:

- ☐ K&E TYPEMASTER Translucent Typewriter Paper
- ☐ K&E Tracing Pads ☐ K&E BANKNOTE Tracing Paper
- ☐ K&E LIGHTWEIGHT SKETCHING TISSUE

Name & Title _____

Company & Address _____

1539

custom tailoring costs less than "ready-to-wear"

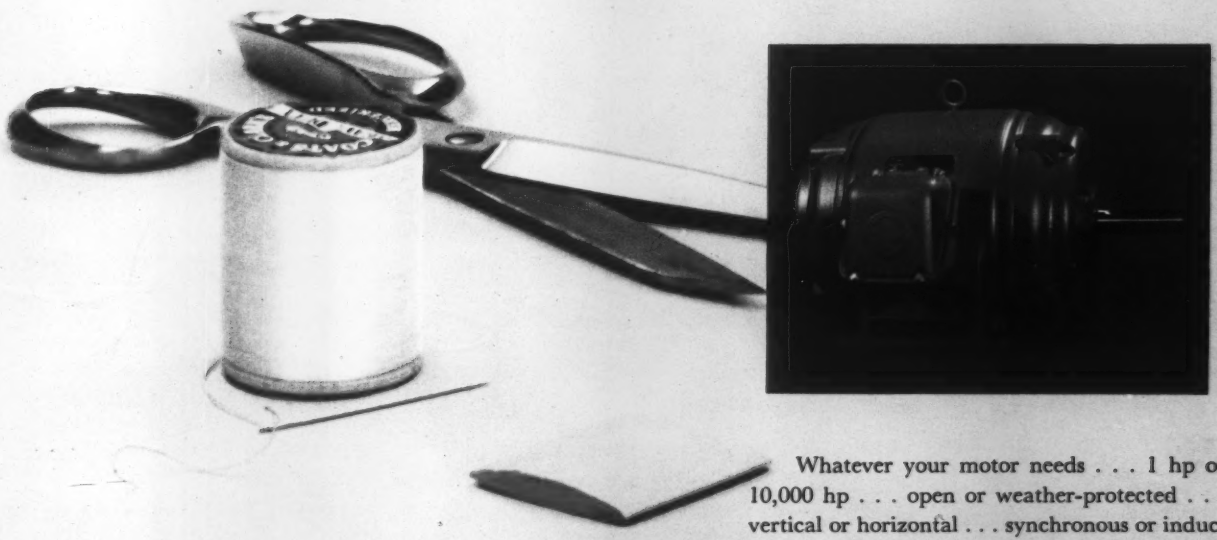
Buying an electric motor with "ready-made" insulation can be a costly luxury.

Motor operating conditions vary so widely throughout industry that Fairbanks-Morse insulation systems are *tailored* to actual operating conditions . . . not *standardized* to "the average".

"Ready-made" insulation systems are an "across-the-board" compromise with *average* operating conditions. When *your* case is the all-too-frequent exception, the compromise is costly.

Even in "hard to fit" cases we build motors rated, dimensioned and insulated to furnish unfailing power. Insulating materials are carefully tested, selected, treated and prepared so that insulation as well as motor enclosure is *matched* to the job. Entire insulation system is custom tailored to meet emergency overloads, temperature extremes, corrosive atmospheric conditions . . . whatever combination of factors affects motor life and performance of your *specific* operation.

This *flexible* application of varied insulating materials and processes "pays off" in low maintenance, uninterrupted production, prolonged service.



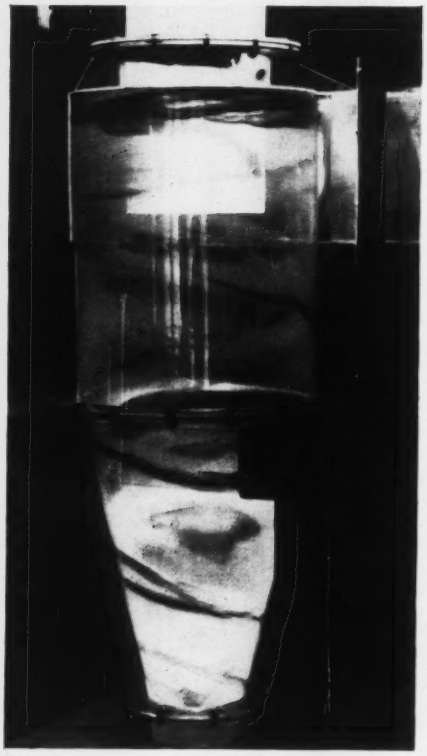
Whatever your motor needs . . . 1 hp or 10,000 hp . . . open or weather-protected . . . vertical or horizontal . . . synchronous or induction . . . AC or DC . . . Fairbanks-Morse builds it, builds it right, builds it to last. Get the facts . . . drop a line today to: Fairbanks, Morse & Co., Freeport, Illinois.

Fairbanks, Morse

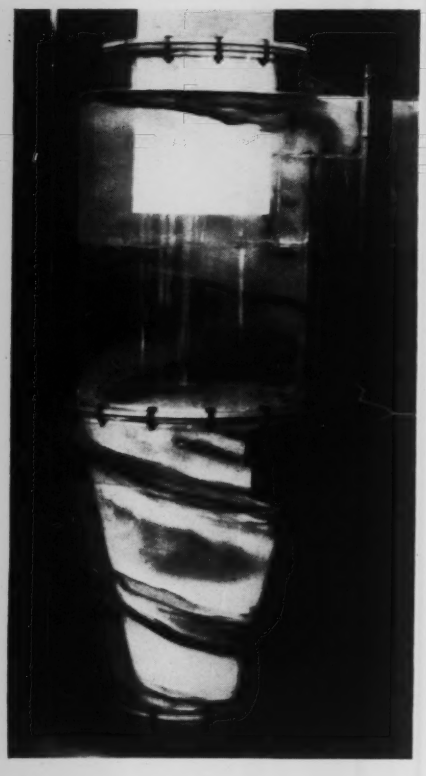
ELECTRICAL DIVISION

A MAJOR INDUSTRIAL COMPONENT OF **FAIRBANKS WHITNEY CORPORATION**

UNRETOUCHED ACTION PHOTOS PROVE SUPERIOR PERFORMANCE OF BUELL CYCLONES



an ordinary cyclone



THE BUELL CYCLONE
with Shave-Off

These are photographs of as true a test as can be made under laboratory conditions. Notice the difference in the dust patterns! In the Buell Cyclone, on the left, the dust at the top makes less than one revolution before it is trapped by the Shave-Off. It's then channeled down to the lower portion of the Cyclone, well below the clean gas outlet.

Why is the Buell Shave-Off so effective? Primarily because it harnesses the double-eddy current to convey the dust "fines" downward quickly, thereby promoting greatly increased efficiencies. In the ordinary cyclone, as shown on the right, these "fines" concentrate and recirculate at the top, causing erosion of the cyclone. To be collected, the fine dust must travel downward close to the clean gas outlet where much of it escapes. Buell Cyclones have made an impressive record in many years of trouble-free service. To see how their extra efficiency in the Shave-Off can pay off for you, send for our Cyclone Catalog #103. The Buell Engineering Co., Inc., 123 William Street, New York 38, New York. Northern Blower Division, 6404 Barberton Avenue, Cleveland, Ohio. (Subsidiary: Ambuco Ltd., London, England.)

buell®
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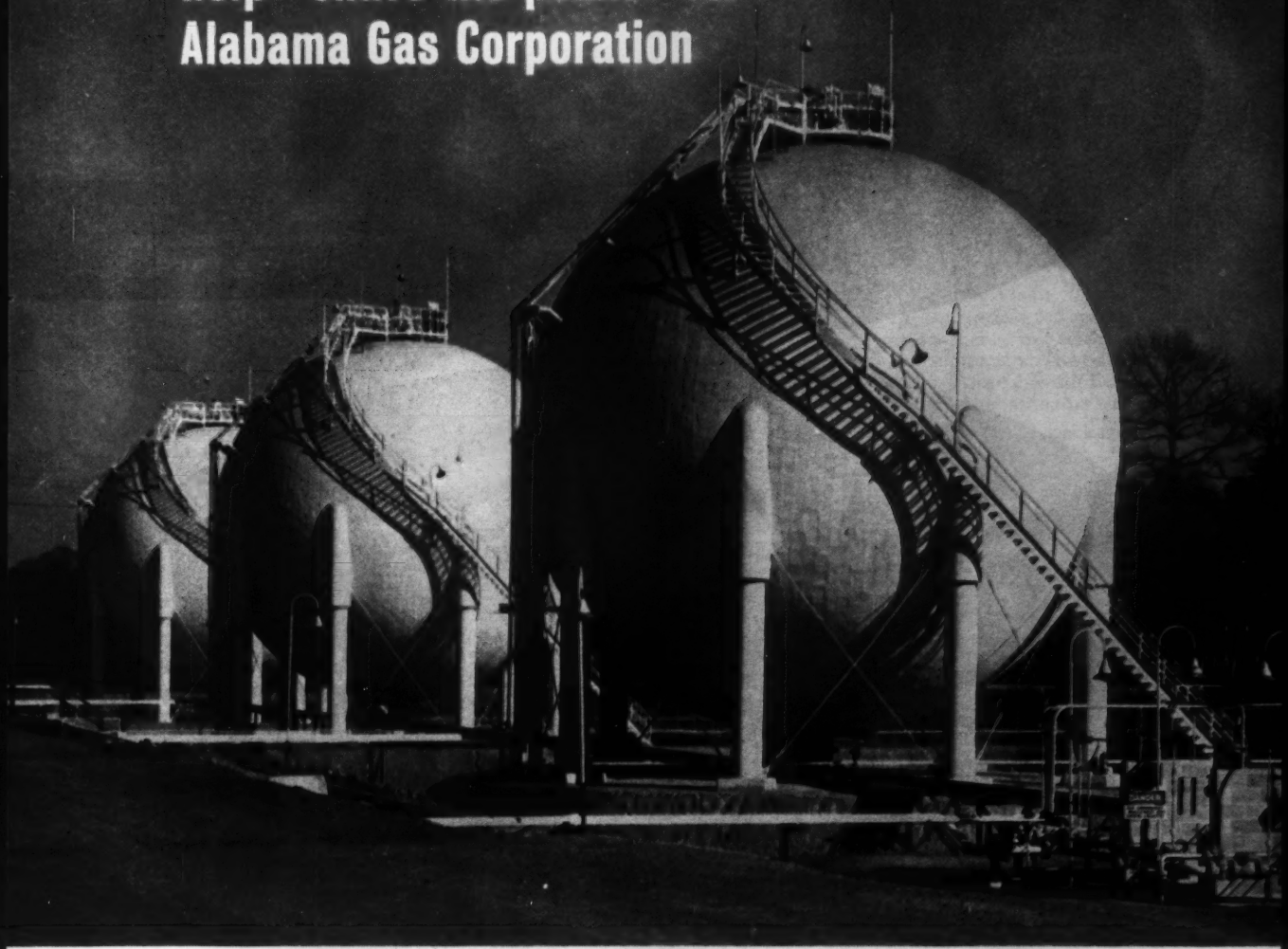
CYCLONES • ELECTRIC PRECIPITATORS • BAG COLLECTORS • COMBINATION SYSTEMS • FANS • CLASSIFIERS

HORTONSPHERES®

help "shave the peaks" for Alabama Gas Corporation



E69CB Propane is stored under refrigeration in these insulated Hortonspheres at Alabama Gas' Birmingham peak shaving plant.

Alabama Gas Corporation supplies the natural gas that feeds the furnaces of 49 growing communities. When cold weather strikes sunny Alabama, the demand for gas skyrockets. This situation calls for "peak shaving" . . . the boosting of normal gas supplies to meet a temporary condition.

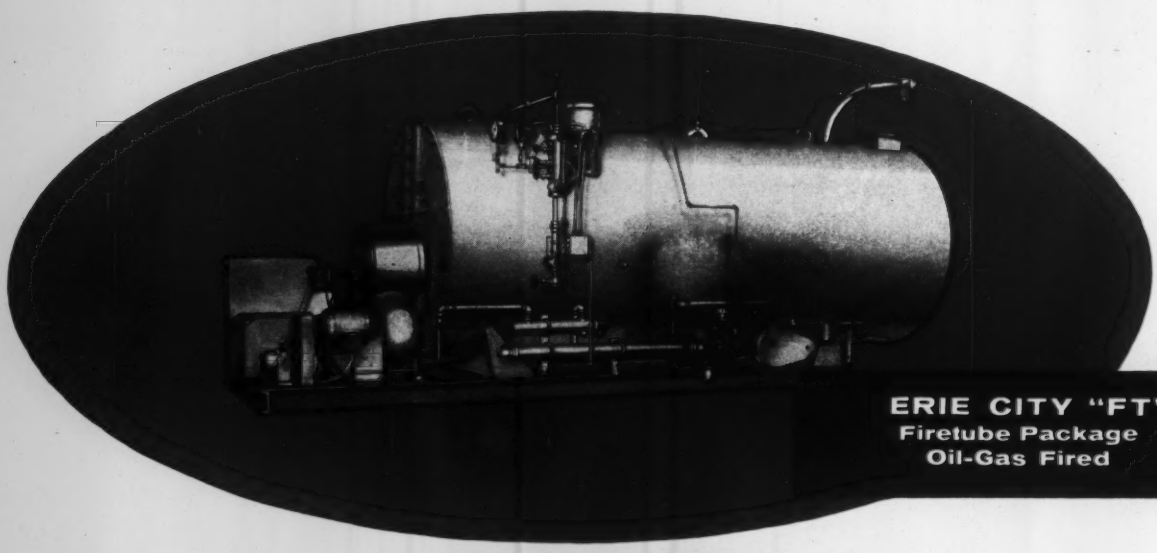
Three CB&I-built Hortonspheres are the heart of Alabama Gas' peak shaving facility. These vessels store some 36,000 barrels of liquid propane at 30°F. to 35°F. During peak periods, the propane is vaporized and further processed to make it compatible with natural gas and is then introduced into the gas distribution system.

Hortonspheres are used extensively for the storage of volatile liquids and gases under pressure . . . with or without refrigeration. Write our nearest office for full details.

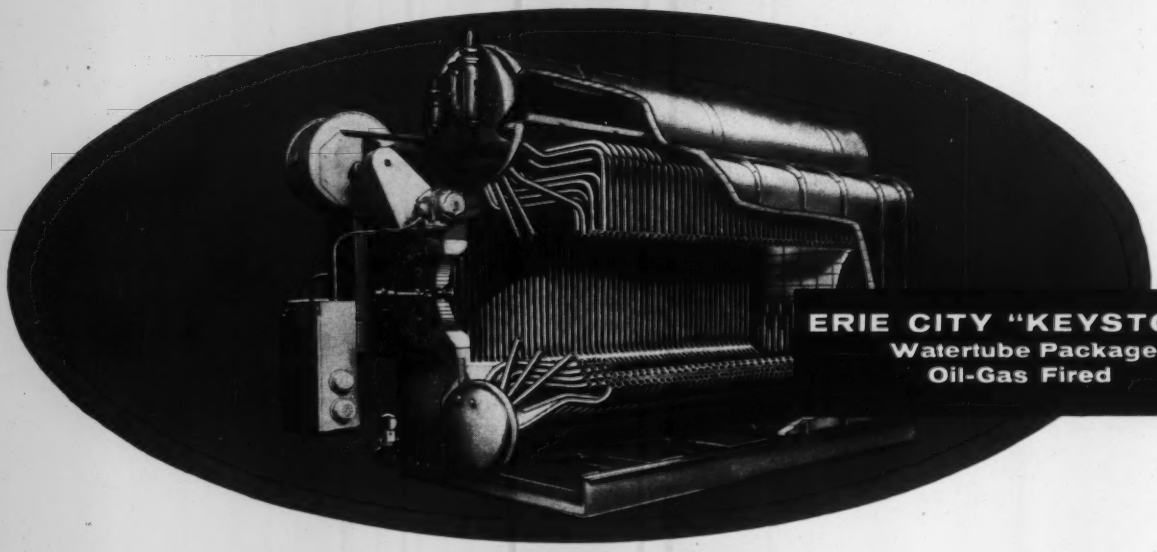
CHICAGO BRIDGE & IRON COMPANY

332 SOUTH MICHIGAN AVENUE
CHICAGO 4, ILLINOIS

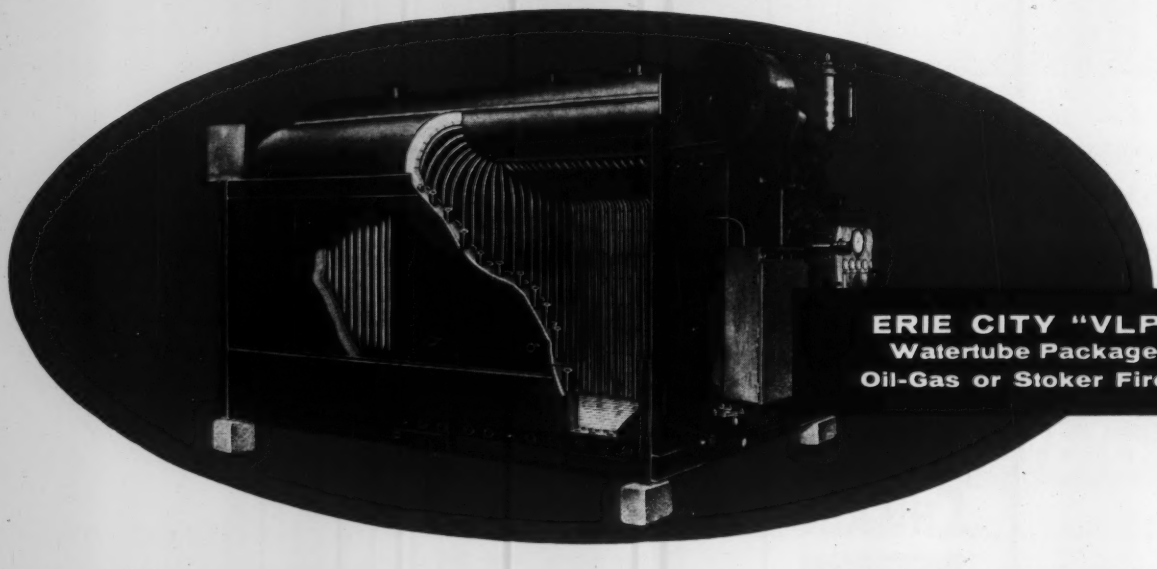
OFFICES AND SUBSIDIARIES IN PRINCIPAL CITIES THROUGHOUT THE WORLD



ERIE CITY "FT"
Firetube Package
Oil-Gas Fired



ERIE CITY "KEYSTONE"
Watertube Package
Oil-Gas Fired



ERIE CITY "VLP"
Watertube Package
Oil-Gas or Stoker Fired

Why shop around for Package Boilers?

Thinking about a new boiler these days? Maybe a package boiler! Sounds like a good idea because many people like this new concept of undivided responsibility. But what kind should we get? Firetube? . . . Watertube? Should it be oil fired, gas fired, arranged for future stoker firing; or which combination of these would be best for us?

The best place to find unbiased answers to your questions is Erie City Iron Works—a pioneer in the boiler industry and a leader in the package steam generator field. Erie City manufactures both firetube and watertube package units. Without prejudice their engineers can point out the advantages of both types.

After hearing the pros and cons of each, you may decide on the firetube type. Erie City offers its modern "FT" Package Boiler arranged with Erie City air atomizing oil gun and/or ring type gas burner. The "FT" Fire Tube Package unit is built to highest quality standards—not down to a price. It is a three pass design with gas vent at the rear and pressurized, using forced draft to provide precise control of excess air and CO_2. A centrifugal fan is used, which coupled to a closed combustion chamber, results in unusually quiet operation. No costly foundation—no expensive stack—no brickwork are required.

"FT" *Cat.* SB5603G

If a watertube boiler is your choice, you have two types available from Erie City. One is the KEYSTONE, the most compact water tube package available, arranged with a steam atomizing oil gun and/or ring type gas burner. The KEYSTONE is a baffleless, two drum unit completely water cooled with a seal welded inner casing and bolted outer casing for pressurized operation. No costly foundation—no expensive stack—no brickwork are required.

"KEYSTONE" *Cat.* SB6303G

The other choice for a watertube package is the VLP. Your plant may be located in an area where gas, oil and coal are all available. At first you may decide to fire with oil or gas but desire the proper provision for future coal firing. The boiler for you to install is an Erie City VLP arranged for present oil and gas firing but with the furnace PROPERLY PROPORTIONED for the future installation of an underfeed or spreader stoker.

All Erie City package units come complete with burners, fans and safety and combustion controls, piped, wired and mounted on the boiler. No field work required—just make basic fuel, water, steam and electric connections and you're ready for operation.

Both the air atomizing and steam atomizing burners are of Erie City's own design and manufacture. No division of responsibility here. Qualified service engineers will assist at start up and instruct your operating personnel. In the case of the VLP, your boiler will be properly designed for future conversion to either Erie City underfeed or spreader stoker firing. Again, no division of responsibility.

Don't let the selection of a new boiler become an unnecessary problem. Write and let Erie City help make the proper selection of a package steam generator for you.

"VLP" *Cat.* SB5703G

• *You can depend on* [redacted] *for sound engineering*

ERIE CITY IRON WORKS *Erie, Pennsylvania*

STEAM GENERATORS • SUPERHEATERS • ECONOMIZERS • AIR PREHEATERS • WASTE HEAT BOILERS
FIRE and WATER TUBE PACKAGE BOILERS • OIL and GAS BURNERS • STOKERS • PULVERIZERS

CLARAGE

"Packaged" fans . . . ready-to-run units for supply and exhaust jobs ranging to 25,000 CFM. Adjustable in-the-field to 8 discharge directions. Available for both outdoor and indoor installations. Send for 36-page catalog containing complete information or contact nearest Clarage sales engineering office.

CLARAGE FAN CO., 619 Porter St., Kalamazoo, Mich.

Please send your Ready Unit Catalog 517.

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COMPANY _____

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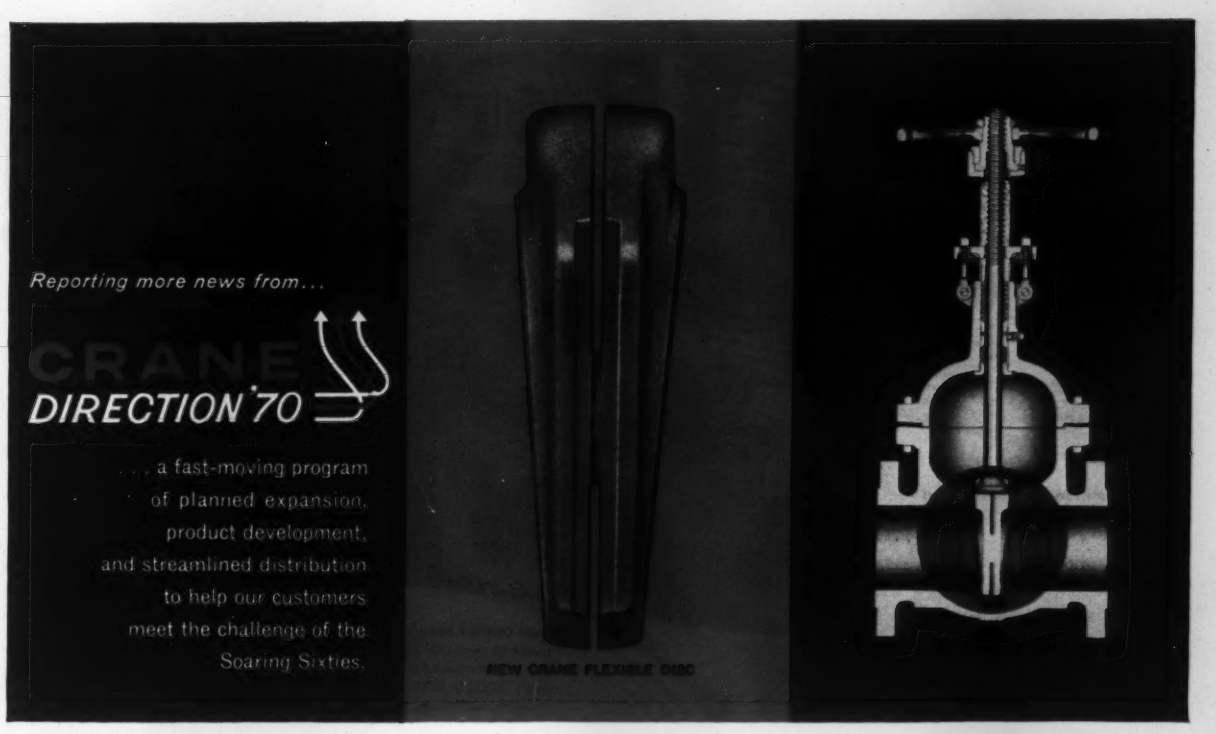
CITY _____ STATE _____

Dependable equipment for making air your servant

CLARAGE FAN COMPANY

Kalamazoo, Michigan

SALES ENGINEERING OFFICES IN ALL PRINCIPAL CITIES • IN CANADA: Canada Fans, Ltd., 4285 Richelieu St., Montreal



The most significant advance in gate valve design in 25 years...

CRANE FLEX GATES®

Instead of being made with a solid disc, new, patented Crane Flex Gates have separate disc faces, connected by the axle-like unit shown in the cross section. This joins the two seating faces, yet provides flexibility for the faces to seat tightly with independent action.

BECAUSE THEY'RE FLEXIBLE, new Crane Flex Gates seat with less torque.

BECAUSE THEY'RE FLEXIBLE, new Crane Flex Gates unseat with less torque . . . will not stick closed even when closed while hot and allowed to cool.

BECAUSE THEY'RE FLEXIBLE, minor deflection of seating faces due to pipe strains does not affect tightness of Crane Flex Gates.

BECAUSE THEY'RE FLEXIBLE, new Crane Flex Gates are tight on inlet seat and outlet seat over a wide range of pressures.

BECAUSE THEY'RE FLEXIBLE, new Crane Flex Gates can be used singly in some services where two conventional gate valves are frequently specified. You can save substantially on piping costs.

BECAUSE THEY'RE FLEXIBLE, new Crane Flex Gates can be serviced—body seat rings replaced or seating faces refinished—quickly, and without painstaking accuracy. Slightly off-taper seats do not affect tightness or operating ease.

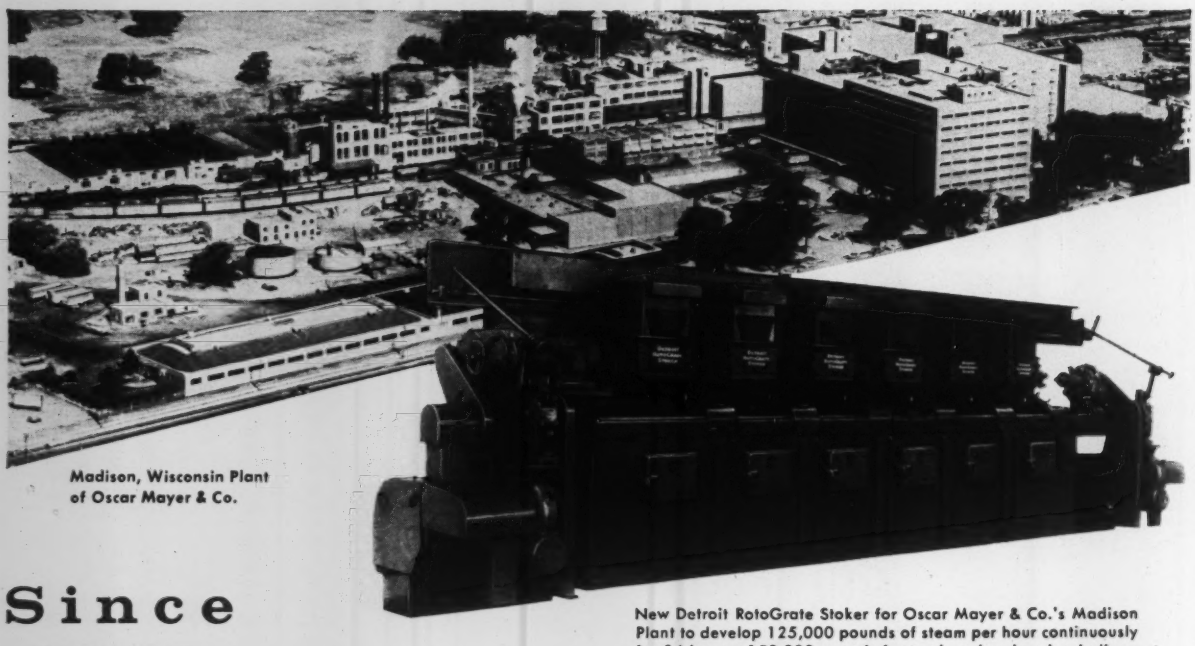
BECAUSE THEY'RE FLEXIBLE, new Crane Flex Gates will easily outperform any conventional solid wedge disc valve you now use. *And there's no increase in price.*

BECAUSE THEY'RE MADE BY CRANE, these new Flex Gates are completely dependable. You can use them with complete confidence on steam, water, gas, oil or oil vapor service. Stem and disc seating faces are Crane Exelloy. Shoulder-type body seat rings are Exelloy or Crane No. 49 Nickel Alloy. Sizes: 12 inch and smaller; 150- and 300-pound pressure classes.

Ask your Crane Distributor for full information on Flex Gates—and for data whenever you work with the products Crane makes. He has the newest in information and products. Crane Co., Industrial Products Group, 4100 South Kedzie Avenue, Chicago 32, Illinois.

CRANE®

VALVES • ELECTRONIC CONTROLS • PIPING • PLUMBING • HEATING • AIR CONDITIONING



Madison, Wisconsin Plant of Oscar Mayer & Co.

New Detroit RotoGrate Stoker for Oscar Mayer & Co.'s Madison Plant to develop 125,000 pounds of steam per hour continuously for 24 hours—150,000 pounds for peaks, when burning Indiana coal, 10530 BTU per pound, 13.25% ash, A. F. T. 1900° F. Helmick and Lutz, Minneapolis, Consulting Engineers.

Since 1938

Detroit Stokers have served Famous Sausage Makers with Economy . . . High Availability . . . Low Maintenance

Oscar Mayer & Co., pioneer meat processing firm, has been making sausages since 1883. By stressing quality and uniformity of product, it has grown from a small meat market on the near-north side of Chicago to the nation's 9th largest producer with sales last year of $260,000,000.

In 1938, the company installed a Detroit RotoStoker in the Madison, Wisconsin, plant. Purchase of a plant in Davenport, Iowa, brought them another RotoStoker in 1941.

These served so well that in 1947, they bought a Detroit RotoGrate Stoker for the Madison plant as a part of an expansion program.

When more expansion was planned in 1959, they bought two more RotoGrates, one each for the Madison and Davenport plants, making a total of five acquired since 1938.

Detroit RotoGrate is an overthrow spreader stoker with traveling grates that move slowly forward, discharging ash at the front. Suitable for boilers up to 400,000 pounds of steam per hour capacity . . . it burns any bituminous coal or lignite and many types of refuse, separately or in combination with coal. It is one of the complete line of Detroit Stokers for small, medium and large boilers.

DETROIT STOKERS COST LESS

DETROIT SINCE 1898 STOKERS

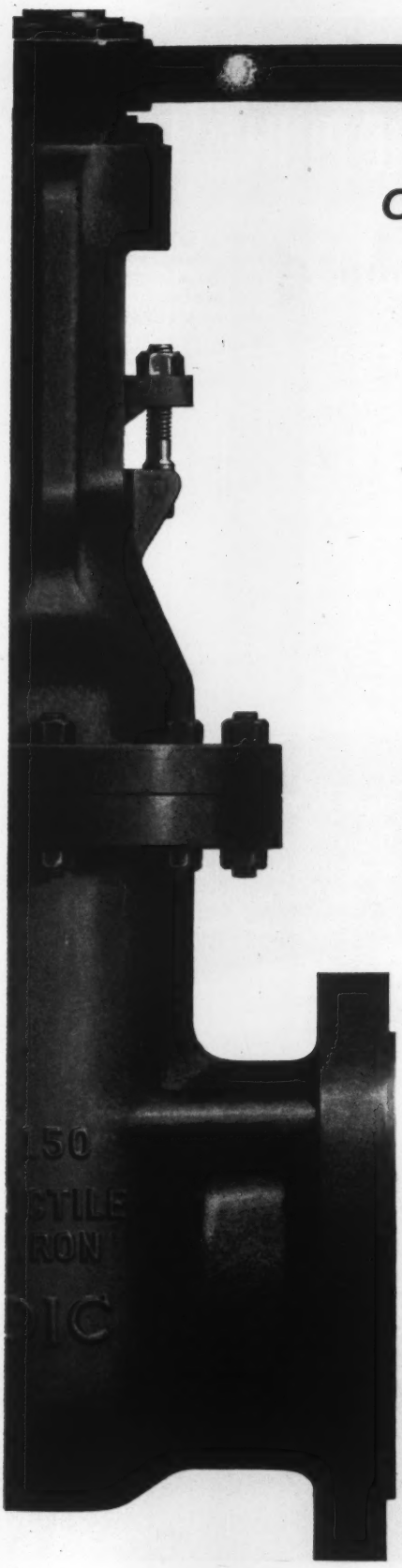
Cost equals initial investment plus upkeep, plus production losses due to equipment outage. *The total is less with Detroit.*

DETROIT STOKER COMPANY

DIVISION OF UNITED INDUSTRIAL CORPORATION

MAIN OFFICE AND WORKS • MONROE, MICHIGAN

District Offices or Representatives in Principal Cities



CHECK OIC FIRST...IT PAYS!

QUALITY and a reputation for quality are not easily attained in the valve business. At OIC we've worked for more than three-quarters of a century, with one unbroken chain of ownership-management, constantly guarding our standards of quality in materials, design, engineering, craftsmanship, and inspection. This long-standing reputation is reflected in the caliber of your nearby OIC distributor . . . a "quality house" with its own highly valued reputation. When you need valves and must be certain of quality, sight unseen, it will pay to phone your OIC distributor. He carries a representative stock of OIC bronze, iron, ductile iron, cast and forged-steel valves . . . and he can get 4 to 5-day delivery from OIC's warehouses or factory inventory. Since quality is a "must," and delivery is urgent, phone your OIC distributor. Quality products and prompt service are his business, and ours.

OIC VALVES

FORGED AND CAST STEEL, BRONZE, IRON AND DUCTILE IRON VALVES

THE OHIO INJECTOR COMPANY • WADSWORTH, OHIO

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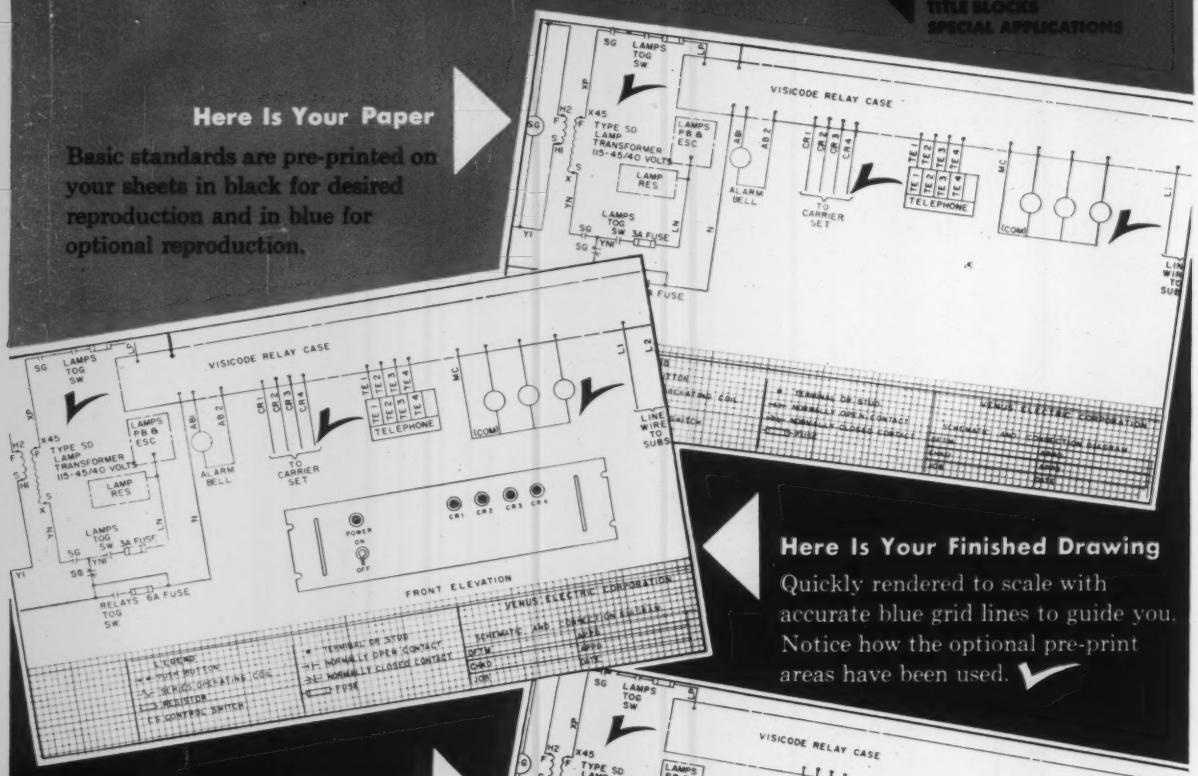

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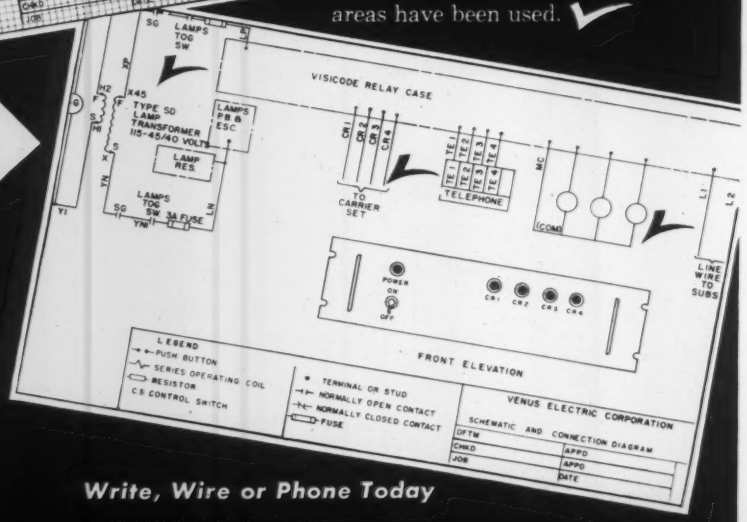

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MECHANICAL ENGINEERING

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That Time Lag

Speaking at the recent ASME Production Engineering Conference banquet, J. L. Singleton directed some pungent remarks at engineers and the challenges of the 1960's that will confront them. Mr. Singleton, who is Senior Vice-President of Allis-Chalmers Manufacturing Company and a member of ASME, pointed out that we are entering a period of literally exploding technology. The question: Will our engineering talents measure up to the job before us or will we misuse these talents? Domestic and international politics, for example, have forced us to compress our research and development progress into a much shorter time cycle.

He reminded his audience that the successful production of the first atomic bomb by the U. S. Government was actually the beginning of the collapsed time cycle in research and development.

In his discussion of the time cycle, Mr. Singleton touched on a point regarded as critical by ASME. Early last fall, the Society set up a program to chop "the dangerous time lag" between scientific discoveries and their practical application. Glenn B. Warren of General Electric, then President of ASME, called such delays . . . "our greatest single handicap in competing with the Soviet and other state-controlled industry."

"There is no real evidence that Russian science is seriously outpacing ours," Mr. Warren said. "But it may well be that the Russians are putting their scientific progress to work faster than we are."

Fenton B. Turck, a Fellow of ASME and a leading consulting engineer, was chosen to organize the Society's effort to speed up the application of new scientific knowledge. Mr. Turck said:

"Scientists must think more in terms of putting their discoveries to work. And engineers must be more alert to use improved products and techniques, be less resistant to change."

In so far as the Soviet Union is our competition, we can and should win. Like so many leading American industrialists, Mr. Singleton has visited Russia, and he gave the assembled production engineers a first-hand evaluation of the difficulties that face Russian industry. This issue of MECHANICAL ENGINEERING contains a report on the Milwaukee Production Conference (page 98) with excerpts from Mr. Singleton's speech. What he saw in Russia did not shake his faith in our supremacy "if we stand united."

"In general," he said, "the engineer's job is to take available scientific information, the materials of nature if you please, and apply them in solving the problem at hand. And in this we have a challenge. To make this challenge effective it is necessary to have a sympathetic team made up of management, engineering, and labor—each member appreciating and respecting the problems of the other."

Under the international competitive situation facing us, many of our new developments normally requiring years before they become practical applications must be telescoped into a shorter schedule. Are we mentally conditioned to accept these rapid strides in technological advancement? asks Mr. Singleton.

Let us hope that U. S. engineers *are* conditioned to meet these challenges—and meet them successfully. The United States must maintain, or better still, increase its technological lead if it is to remain the world's undisputed leader in engineering and science.—*J. J. Jaklitsch, Jr.*

Editor, J. J. JAKLITSCH, JR.

The Engineer

By Irwin L. Tunis, Assoc. Mem. ASME

Registered Professional Engineer,
Attorney at Law,
New Orleans, La.

To PROVIDE a basis for judgment, the law has created an artificial individual and endowed this individual with all of the desirable qualities of a citizen of the community. Whenever an individual is on trial, his behavior is always compared to what this ideal nonexistent individual would have done if he were in a similar situation.

The names given this encapsulation of all admirable human qualities are: "Average reasonable man," "prudent man," "a man of ordinary sense using ordinary care and skill," or any other adjectives to denote this concept.

Because of the infinite number of situations that can confront an individual, it is impossible to fix definite rules in advance for all human conduct. Since the law does not have any favorites, the standard must be objective. The "reasonable man" represents the minimum standard of conduct permissible, below which an individual would be liable in damages for his conduct. If the individual has knowledge, skill, or intelligence superior to that of the ordinary man, the law demands a conduct consistent with such an attribute [1].[1]

The "prudent man" standard has been raised to encompass these new qualities. Therefore professional men are required to exercise not only the ordinary skills of everyday living, but also to possess a minimum of special knowledge and abilities consistent with their chosen profession.

Since engineering by definition is a profession, engineers are expected to have the skills, knowledge, and abilities consistent with the average reasonable man engrossed in this field. It is also assumed that if the engineer holds himself out as having greater skill than is possessed by his colleagues, the standard is again raised.

Application to Engineering

In the 1915 case of *Cowles vs. City of Minneapolis* [2], the court held that since the plaintiff was hired as an engineer, he need only exercise such care, skill, and diligence as the men engaged in the profession would ordinarily exercise under like circumstances. Expert witnesses, custom, and experience level would be some of the factors that would be given cognizance by the court in determining this standard.

The Cowles case dealt with a professional engineer, an individual legally licensed to practice his profession, and it is with the licensed professional engineer that the state primarily concerns itself. A professional engineer is usually defined as a person who, by reason of his special knowledge of mathematics and the physical sciences, methods of engineering analysis and design, acquired by professional education and experience, is qualified and permitted to practice engineering [3].

This does not mean that everyone who labors for an industrial corporation or a firm under the title of engineer, who is not licensed, is committing an illegal act. The appropriate licensing act in most states exempts such individuals from obtaining a license as long as they are performing services in the scope of their employer's business. It is only when they step outside and serve the general public directly that an illegal act is performed for which penal sanctions may be invoked. Usually the exemption does not apply to the practice of civil engineering and land surveying. It is advisable for an individual in doubt to consult a copy of the appropriate statute. This can be secured quite easily from his Secretary of State.

A nonregistered engineer cannot affix his signature as such to engineering plans, estimates, or specifications [4]; therefore he is denied credit for a job well done and cannot engage in any professional capacity outside of his job on an individual basis. A corporation or a firm will not be granted a license since licensing is restricted to natural alive persons [5].

Implications for All Engineers

This is of interest to all engineers, because one need not be paid for any engineering work contracted outside his employment if he is not licensed. The case of *Clark vs. Moore* [6] held that: "Investigation, design, and cost valuation in connection with obtaining an award of a contract for work at a military base constituted engineering services. Compensation could not be recovered by one not having first obtained a license." Usually the person who contracted for the engineer's services can use the information and not be subject to any penalties [7]. The defendant may then truly obtain something for nothing. The question of whether engineering work was involved is a question of fact and is usually determined by a jury.

The theory behind this concept is that licensing is a police power of the state and not a revenue measure. Therefore an individual cannot sue on a theory of *quantum meruit*[2] when the contract itself is illegal.

Multiple Licensing

The individual who has become licensed to practice a particular engineering specialty is not given carte blanche to practice in every field. With the horizons of engineering widening, and the formalistic boundaries separating the fields disappearing, the problem of where to draw the line becomes more difficult. This was met by the judiciary in the 1942 Utah case of *Smith vs. American Packing and Provision Company* [8]. In this case the plaintiff, a registered structural engineer, entered into a contract with the defendant meat packers in Ogden, Utah. The defendant argued that he need not pay the plaintiff because the plaintiff, Smith, performed architectural work and was not licensed in this field. The court in holding for Smith set forth a test to be used in determining whether a man should be a multiple licensee, ruling that a licensee does not need a license for each field into which his profession may overlap, unless such requirement is imposed by statute. The court went on

[1] Numbers in brackets designate References at end of paper.

[2] Literally "as much as he merited"—applying to an action brought on a promise to pay as much as the person deserved for his services.

to say that the real criterion for determining whether an engineer needs another license is not whether the service he performs may be performed lawfully by another, but whether such functions are embodied in the field for which the license was granted.

The test is then "the scope of the field embodied by the license." This clause may be termed an accordion clause. The narrowness or breadth of the clause becomes dependent upon the judicial determination of the legislative intent.

Practicing Out of State

It was mentioned previously that an unlicensed engineer need not be compensated for work done in engineering. The question now arises, can an individual perform services in a state for which he is not licensed? Theoretically the answer is no. However, almost all of the states permit the issuance of a temporary certificate by the appropriate regulatory body. There are usually two provisions: The practice in the second state cannot exceed in the aggregate 30 [9] to 60 [10] days in any calendar year, and, second, the board must feel that the registration requirements in the engineer's resident state are not lower than in the state in which he is applying for a certificate [11]. The second provision is the discretionary one. There are also provisions in the state acts which set forth permanent transfer of licenses.

If an engineer does not wish to obtain a temporary permit for any of a variety of reasons, he can pursue several courses of action. He can enter into an agreement with a local licensee, or do the work, if possible, in his resident state. In a 1955 [12] decision where a licensed Washington engineer entered into a contract in Idaho, the actual engineering work was done in Washington. The court held that the plaintiff was not practicing in Idaho and, hence, should recover his fee.

Penalty for Unlicensed Practice

If a person is convicted of practicing without a license, penal sanctions could be invoked. Many state acts [13] have provision for conviction of a misdemeanor with the appropriate jail sentence, a fine, or both. In Louisiana, each day of violation constitutes a separate offense [14]. If a corporation or firm is found guilty, the fines are naturally prorated upward. However, most statutes do contain "saving clauses" in which recognition is made of the practice of the physical sciences, such as chemistry and physics. There is no license required for such practice. Also, an individual who repairs radio and television appliances who lists himself as an electronic engineer, hiding behind the facade of a trade license [15], is guilty of a misdemeanor. An engineer, licensed or unlicensed, should be aware that there is a tort[3] concept of negligence through misrepresentation. There does not have to be a reliance by the injured party on the words of an individual as conduct is usually sufficient. Any misrepresentation could possibly entail the tort action of deceit, although deceit is usually restricted to credit transactions. Since this is not a paper on negligence, the very important question of engineering malpractice will not be discussed.

There is still another important function of the engineer and his relation with the law. That is in assisting an attorney. An attorney, when he participates in litigation involving a scientific or technical question, may put his client in a better position by using engineers as expert witnesses. It is natural to assume that the attorney will initially turn to a registered engineer for his opinion. The expert's fee may be quite lucrative.

The technical individual can also be of invaluable assistance in preventing possible litigation by assisting in various contract negotiations, the writing of the contract, and by reminding everyone of the Engineers' Code of Ethics.

[3] A wrongful act which does not involve breach of contract for which civil suit can be brought.

and the Law

When you perform in a profession, you accept responsibilities that are legally binding. As an engineer you should be aware of what the law expects of you.

Conclusion

If engineers want professional status comparable to that of the medical and legal professions, they should become licensed. It is only by the use of a licensing provision that engineers can be truly given the stature of professionals. The indiscriminate use of the name engineer by salesmen, repair men, and personnel people can be severely curtailed by invoking the act's penal clauses.

It is foolish for a man to spend a college career training to be an engineer, work as an engineer, and then have no standing before the law as a professional because he is not licensed.

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2 Cowles vs. City of Minneapolis, 128 Minn. 452, 151 N.W. 184, 1955.
3 Usdin vs. Kvatinetz, 69 N.Y.S. 2d 634, New York, 1947.
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4 The Louisiana Licensing Act was used primarily as a reference because this act is similar to equivalent acts in many other jurisdictions. Hereinafter the act will be referred to as LSA R.S. 37: 681–697. This reference is LSA R.S. 37: 681, 698.
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14 LSA, supra reference [13].
15 LSA R.S. 37: 682, Op. Atty-Gen., 1956–1958, p. 281.

a special report

SAFETY in MATERIALS HANDLING[1]

AN ENGINEERING APPROACH[2]

By W. J. BYRNE

THE handling of materials is the principal single source of work accidents and injuries in American industry. Quoting from reliable records, 25 per cent of all injuries stem from some form of materials handling.

A recognized aim of a good industrial safety program is to "build in" accident-prevention measures, both in work procedures and physical facilities, and thus greatly minimize the unpredictable human factor inherent in all of us. Present-day machine guarding and dust-and-fume control are examples of successful, built-in safeguards.

In the field of materials handling, the achievement of built-in controls has been spotty. Despite the ever-increasing use of mechanical aids such as lift trucks, cranes, and conveyers as a means of bypassing manual "muscle moving," hazards and injuries remain numerous.

Safety people work long and hard, trying to come up with more effective means of educating individual workers in safe handling methods. Despite numerous recognized successes here, many efforts are doomed to failure on a long-range basis. A re-examination, considering both hazard and inherent injury potential, is called for.

The tendency of business firms to place safety activities under Personnel or Industrial Relations, rather than under Methods Engineering or Production, is one of the major reasons why accident-prevention efforts are limited.

Uncovering the Facts

A review of process charts, layouts, and individual operational studies—all tools borrowed from methods engineers—is presented briefly in this paper.

The flow process chart is a written record or charting of a materials-handling cycle, calling for data on the material to be handled, the methods of handling and transport, the distances moved, and similar information.

Coincident with process charts, layouts of the arrangement of production machinery, work centers, and auxiliary activities provide means of tracing the physical route of materials and determining how adequate available space may be.

The individual operational study focuses on the recording of the handling requirements of machine and equipment operators, fabricators, assemblers, and materials handlers themselves.

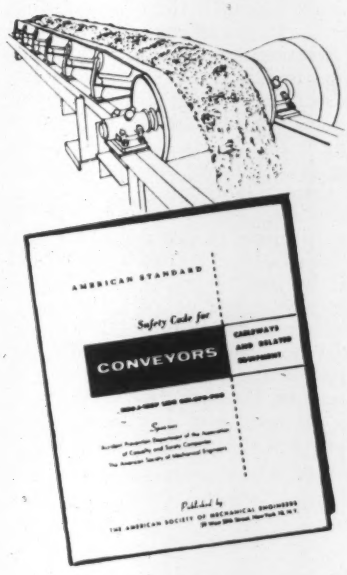
The procedure is simplified greatly by breaking down similar handling routines into a reasonable number of groupings or classifications.

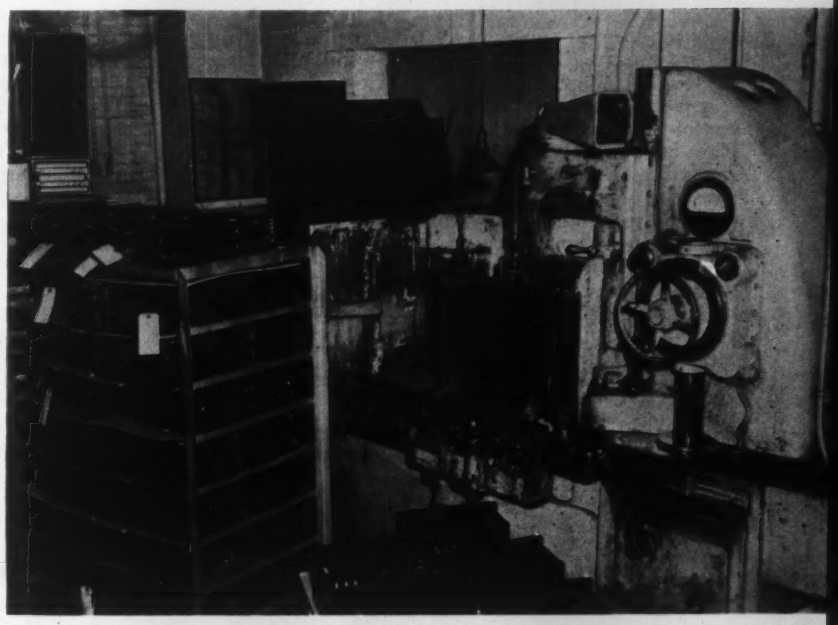
The work involved need not be an overwhelming task. Detailed handling data associated with one commodity can be applied effectively to all similar situations. In a paint-manufacturing concern, the handling of a drum of one chemical would be employable for analysis of other drum chemicals in similar usage. Recorded data on the handling of small, medium, and large castings would have wide, recurring application at turret lathes, milling machines, and drill presses.

[1] Based on three papers contributed by the Safety and Materials Handling Divisions and presented at the Annual Meeting, Atlantic City, N. J., November 29–December 4, 1959, of THE AMERICAN SOCIETY OF MECHANICAL ENGINEERS.

[2] Condensed from "An Engineering Approach to Safety in Materials Handling," by Walter J. Byrne, president, Walter J. Byrne and Company, Inc., Industrial and Marine Consultants, New York, N. Y. ASME Paper No. 59—A-253.

Industrial accidents carry a heavy price tag—$500 million a year. But—you pay for safety, whether you buy it or not.





HORRIBLE EXAMPLE. Behind the grinding machine, back of the hanging lamp, is an elevator door—used constantly. Note the condition of the aisle. That elevator served a five-story building on one side, a four-story building on another, and a third-floor siding and ground level on a third side. "Impossible" is the word.

Analysis

The gathering and recording of operational data are followed by the analysis phase. Most simply defined, this is a testing out of actual procedures by a series of pertinent questions aimed at isolating potential injury-producing conditions. Suggested questions, some of which overlap for greater assurance of completeness, are:

1 Can the handling operation be eliminated in whole or in part? If a "don't touch" idea is applied diligently and open-mindedly, the results may be most fruitful. An important axiom of efficient materials handling often has been stated as: "Efficiency in moving materials is best obtained by not handling them."

2 Can the handling operation, assuming it is a required one, be carried out in a simpler, safe manner?

3 Does the handling operation call for the transfer of materials from the floor to a platform, conveyance, or vice versa?

4 Are work places so arranged as to require machine and equipment operators and assemblers to do a considerable amount of manual lifting, bending, stretching, etc.?

5 Concerning individual materials or unitized packages which must be manually lifted, are the weights within a reasonable range? Is the added problem of a required positioning element, coupled with a manual lift, taken into account? Are the limitations of female workers allowed for? Where time study is used, do the standards allow for (and enforce the use of) crane time at prescribed weight limits?

6 Are all dangerous properties of the materials themselves accounted for?

7 Are raw materials, materials-in-process, and finished parts and products stored in neat, stable piles? Is ease in rehandling taken into account?

8 Are materials of different types, sizes, and shapes segregated so as to insure a minimum of reshuffling?

9 Does the plant layout provide adequate storage areas in both warehouse and production areas?

10 Are definite routes of travel established, and sufficient unobstructed aisle space available, so as to avoid congestion and uncontrolled movement of materials-handling equipment?

11 Are overhead cranes, lift trucks, and other mechanized handling equipment of sufficient capacity to sustain safely the loads to be applied?

12 Does a preventive maintenance program insure the continued availability of sound equipment?

13 Are employees well grounded in safe handling methods of a routine nature? Are special instructions given employees as to safe handling methods of a nonrecurring nature? Is protective apparel (gloves, safety shoes, and the like) required where potentially hazardous conditions exist?

Easiest—and Safest

As these and other pertinent questions are asked about every step in the materials-handling process, safety deficiencies emerge. No single handling category can fail to benefit from such a survey.

Underlying all of the foregoing fact-finding and analysis procedure is work simplification, utilizing the well-known and oft-repeated guiding principle, "The best way is the easiest and safest way."

a special report

THE PLANT LAYOUT[3]

By J. W. HALL

MEN and machines working together present an ever-present potential for accidents. Machines break down. So, also, does the constant vigilance that is necessary to control these machines. And human failure far exceeds mechanical failure.

It would, therefore, seem in order to attack the problem of industrial safety by starting with "planning the plant layout." It would appear to be an investment for the future of any company to apportion funds to "eliminate the accident before it happens" by the establishment of a plant-layout department. This department will seek out and remove from the operations those conditions containing the "inherent hazard"—built in because of ignorance, or disregard, or haphazard planning.

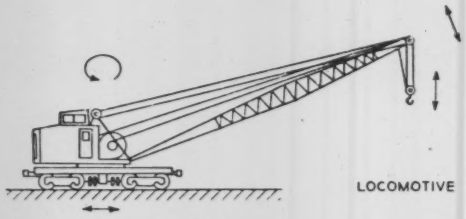
Building design, aisles, storerooms, platforms, column spacing, cranes, hoists, industrial trucks, conveyers, and all other facilities necessary to create the "one best method of manufacturing" must be considered.

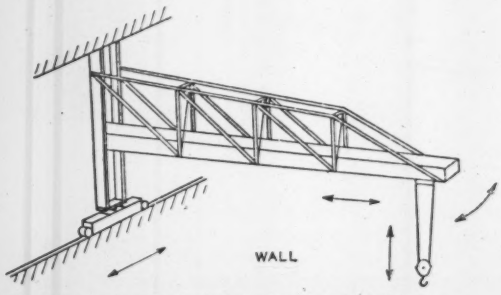
[3] Condensed from "Planning Materials-Handling Safety Into the Plant Layout," by J. Wellington Hall, Supervisor of Material Handling, Equipment and Methods, Westinghouse Electric Corporation, Newark, N. J. ASME Paper No. 59—A-252.

The Project Engineer

The planning of the plant layout is the responsibility of the "project engineer." In his efforts to gather the pertinent information necessary—to develop the best method of manufacturing—he is in constant contact with supervisors and employees of all the departments in the entire operation. He pieces together the bits to develop an over-all plan, starting with material or product, and the supplier's packaging. He follows through with receiving, raw-material stores, fabricating, processing, manufacturing, warehousing, and shipping. He is vitally interested in every phase of the cycle, for any function not properly planned and integrated in the proper sequence is a potential for future problems in manufacturing, stores, transportation, and, of course, safety.

He does not talk materials handling at this stage, though he is constantly in communication with the materials-handling department. He is lining up, in sequence, every operation in the manufacturing cycle. "Manufacturing cycle," as used here, begins with the suppliers of raw materials and ends with delivery at the customer's dock.





THE OLD AND THE NEW at Westinghouse in Newark, N. J. Old press room, **left,** lacked space around machines, lacked service facilities. At **right,** three such old press rooms have been combined into one spacious building with safe aisles, and with overhead crane to service machines.

The intelligent plant layout is produced by using the talents of the plant-layout engineers, the time-and-motion-study engineers, the manufacturing groups, the materials-handling engineers, and any one in the organization who can contribute something toward the best method that can be devised. And this includes the safety engineer.

Supervisor of Safety

A plant safety program, to operate properly, must be headed by a supervisor of safety. He will have the ability to analyze in the planning stage the potential for accident. He will suggest improvements to eliminate a condition that he feels needs further consideration. He will suggest changes. If he is not then satisfied with the method or the changes made, he will then demand that a proper solution be found to the problem.

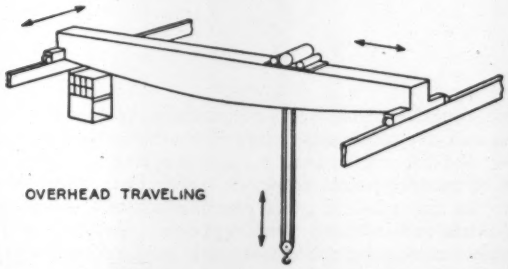
He should keep detailed records of the history of the causes and effects of accidents. He will insist on immediate correction of unsafe practices as he detects them or as they are reported to him. He should head a team of shop personnel—hand-picked—to be his eyes and ears as safety observers. He should conduct a training program for all shop and supervisory personnel.

He will insist that, for every operation involving materials-handling equipment, specific rules for safe operation be issued and enforced. He should belong to the technicalsafety groups and should keep abreast of the programs of other technical societies to benefit from their programs. In short, he is a man with a mighty important job to do.

He must recognize this himself, first of all, and, by building his store of knowledge of his field, impress those about him with the fact that he is a mighty valuable man to have around because he has something to contribute. He must not let himself be considered as the man who goes around with the pencil and paper after an accident to gather statistics.

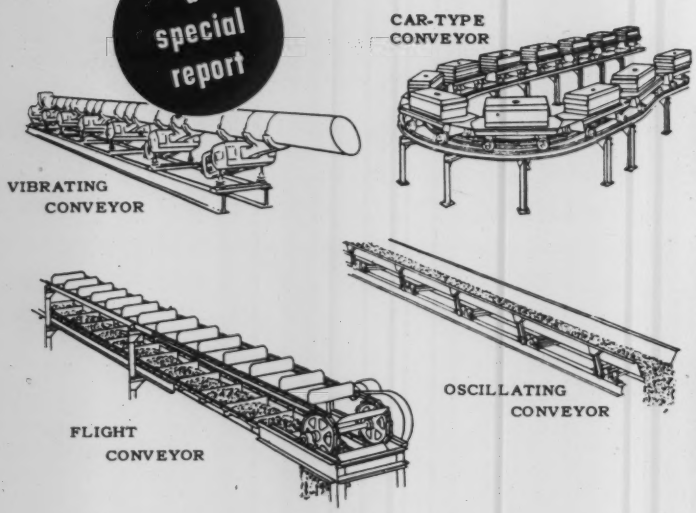
Economics of Safety

Depending on the various sources responsible for the issuance of such information, materials handling is estimated to account for some 25 per cent of all industrial accidents. The cost is estimated to exceed one-half billion dollars per year in compensation and related claims. This is a staggering figure which warrants the attention of all industry in a concerted effort to reduce this dollar loss. According to various company estimates, materials handling is responsible for 20 to 40 per cent of the manufacturing dollar spent. It is acknowledged that here lies a field for cost reduction. But what about the compensation dollars due to materials-handling accidents? This is as fertile a field for cost reduction as materials-handling operations themselves.



OLD AND NEW, AGAIN—but worse. **Left,** the old raw-materials stores area. Note congestion, unsafe stacking, low headroom of building and bridge crane. **Right,** new method of delivering bar stock to mezzanine by crane.

a special report



SAFE CONVEYERS[4]

By J. C. WEBB, Mem. ASME

LARGE ROLLS of paper on turntables. The hoops hold electric eyes off the floor so that walking through will not trip them.

IN PRACTICALLY every industry one or more conveyers are integral parts of manufacturing assembly. They are providing continuous mechanized processing facilities, are tied in with storage, warehousing, shipping, and receiving activities; or, at the least, are transporting raw materials, parts, or fuel from one place to another in the plant or from one building to another. These units move powerfully and mechanically, and consequently safety features are as essential to them as they are to machine tools, power trucks, or other mechanical devices.

The Safety Code

The Safety Code[5] treats these and other conveyers and related equipment generally and specifically. It speaks of general design in this way: Guard driving machinery; don't load beyond rated capacity; design mountings in such a way that catching sharp edges or possibility of pinching is minimized. Keep lubricating points piped out to safe locations; make adjustments to takeups or drives accessible. Use antibackups and antirunaway mechanical safety stops on slopes as protection in the event of chain breakage. Use load brakes as overload cutout protection. Enclose counterweights. Use guard rails. Interlock conveyers electrically to prevent jamming and danger which occurs when one conveyer shuts down and the one feeding is still operating. Watch design of transfer points from one conveyer to another, as here lies the possibility of pinch point and dangerous free materials. Make sure supports, particularly for portable conveyers, are substantial, to stand up without tipping under loads.

The Code covers clearance and accessibility: Leave space for maintenance and for operators; provide visibility so oncoming loads may be seen; up high, provide guarded catwalks. Wherever wall or floor openings occur, guard with rails—these are dangerous points. Provide inspection doors and peepholes where conveyers are enclosed. Make proper provision for crossovers, aisles, passages, leaving ample clearance and headroom. With paint, signs, and/or lights, clearly define these ways of travel.

Inspection and Maintenance

Under inspection and maintenance, the Code suggests the importance of lubrication on a regular basis. Keep takeups properly adjusted; examine cottered connections and couplings for weaknesses. Replace worn parts.

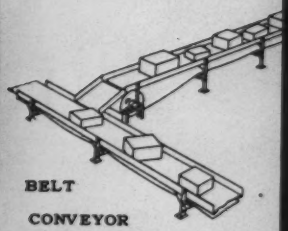
The Code advises that related structures such as tunnels, pit hoppers, and chutes should be considered in the over-all safety design.

General safety rules might be built around these admonitions: Obey rated-load signs. Mark stop and start stations clearly, and make them easily accessible; place them where they provide a clear view of the conveyer. No riding on conveyers; no stepping on conveyers. Don't service conveyers unless on regular maintenance crew. While servicing, stop the conveyer

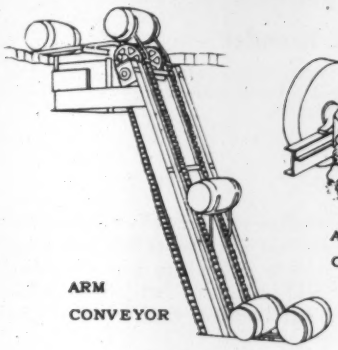
[4] Condensed from "Materials Handling Without Accident," by Jervis C. Webb, president and general manager, Jervis C. Webb Company, Detroit, Mich. ASME Paper No. 59—A-251.

[5] The first published Code on this subject came out in 1947, called the "American Standard Safety Code for Conveyors, Cableways and Related Equipment," known as ASA B20.1. Three years later, in February, 1950, the author of this paper became chairman of a reorganized committee to revise and bring the Code up to date. This committee then became known as Sectional Committee B-20 on Safety Code for Conveyors and Related Equipment. In 1957, the existing Code was revised and approved as ASA B20.1–1957.

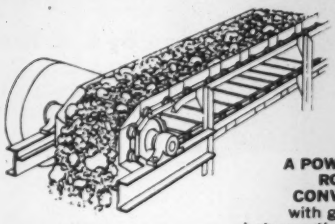
ANTIRUNAWAY for an overhead trolley conveyer. **Left,** the arm easily rides over the trolley wheel traveling at normal speed. **Right,** in case of chain breakage, the speeding wheel slams the lever and releases the steel bar that blocks the track.



BELT CONVEYOR



ARM CONVEYOR



APRON CONVEYOR

A POWERED ROLLER CONVEYER with guards between the rolls to prevent hands or feet from slipping through. Scissors action could be disastrous.

and lock out normal starting push-button stations. In case of overload cutouts, locate jam and use lockouts before starting or servicing.

Relation to Other Codes

The Code refers specifically to its relation and dependence on other codes. These include codes of mechanical power-transmission, electrical, elevators, dumbwaiters, escalators, cranes, derricks, hoists, buildings, bridges, walkways, floor and wall openings, railways, toe boards, dust explosions, and boiler construction. The ASME, ASA, and ASTM code numbers are listed therein.

Turning to specific conveyers, the Code suggests: A smooth cover under slat conveyers, where there is space between slats, to prevent shearing hazards; safety provisions for men who must ride on trippers or belt conveyers; totally enclose bucket elevators; hand rails, smooth sides; guard plates along chain conveyers to protect hands, feet, and clothing; stops are needed at open ends of gravity conveyers. Try to eliminate all pinch points on live roller conveyers. Employ substantial guards with sides under overhead trolley and power and free conveyers. Use solid covers on screw conveyers when possible.

Safe Use of Conveyers

Just a few suggestions for safe use of conveyers in general: When you have bought a conveyer and it is installed, even though you need it badly, don't start using it for production until it is formally turned over to you by the manufacturer or erector. The systems must be run, the bugs must be taken out of the automatics, clearances between guides and moving parts may need to be relieved. It's practically impossible to design and build a conveyer system that does not need any field adjustment after shipment and after the variations in the user's plant are taken into account. By far, the most accidents have occurred at this point.

If a conveyer is being serviced and is shut down, as it should be, watch that the work is not being done too closely to another moving conveyer. Serious accidents have occurred where the service man, absorbed in his work, leaned back into another moving conveyer, or a slowly moving load came along and squeezed or pinched him against the stopped conveyer or to a wall opening.

Watch loading of conveyers. Be sure the hookup is secure if it is a hooking job. If materials are piled on the conveyer, watch that they aren't top heavy.

Remember clearances between conveyers and walls. Clearance for a man to walk through should, where possible, be based on the largest load carried on the conveyer.

Authorize certain persons to operate certain conveyers just as you would a machine tool. Keep others from starting the system. Speed variations in conveyer lines should be entrusted to one who understands what effect these changes might have on the system as a whole.

If overload cutouts are continually operating, or shear pins continually shear, contact the manufacturer of the equipment and find out the cause of jamming. Check as to whether the system is overloaded by means of a dynamometer. If the design is light, get it heavied up before trouble starts.

Have a number of push-button stop stations along a conveyer line. Insist on electric ground wires, particularly on portable conveyers and systems operating in the outdoors or in damp places. Insist on heavy, high-quality, electrical equipment. Stay on the high side of electrical codes.

Man-Generated POWER

Presenting data for human power generation by cranks and pedals. How do these "motor tasks" conflict with control of a machine?

By E. S. Krendel[1]

Franklin Institute Laboratories for Research and Development, Philadelphia, Pa.

Our present interest in man as a power-generating device has two bases: (*a*) We have a desire to be able to integrate our knowledge of how man's energy resources function with our knowledge of how man operates as a control device. (*b*) There are practical and immediate problems which arise when man is called on to generate power.

1 For either safety or military reasons it may be necessary for man to be capable of operating certain devices when other power sources fail.

2 Limitations of space and weight as would occur in space vehicles may be such that power augmentation is logistically expensive. If the human is a passenger acting as an observer, he may have to act as sensor, controller, and, to a modest extent, power source as well, to pay his way.

Cranking Through Small Radii

In the early 1950's the Bilodeaus [1–5][2] carried out a series of experiments called forth by the observation that performance while either working or learning was characterized by decrements in response as a result of continued responding. This formal similarity gave promise that learning theory concepts might apply to repetitive motor tasks.

The cranking apparatus they used had a crank handle capable of rotating in a horizontal plane with a radius of rotation of 4.5 in. Five different resistive loadings were provided by the braking force of a tachometer generator. For any given loading, the power generated was a gently accelerated function of rate of rotation. The general experimental procedure was for the subject to stand facing the crank and, holding it with a standard grip, to rotate it as fast as possible. The power generated in this crank sprint could be measured from the number of revolutions over 5, 10, or 20-sec intervals (Fig. 1).

[1] Head, Engineering Psychology Branch.

[2] Numbers in brackets designate References at end of paper.

Contributed by the Human Factors Group and Management Division of ASME, and the Human Factors Society, and presented at the Annual Meeting, Atlantic City, N. J., November 29–December 4, 1959, of The American Society of Mechanical Engineers. Condensed from Paper No. 59—A-190.

In view of the demonstrated recovery of power-producing capacity following a rest after working, one might seek that rest period which yielded an average power, over a given time interval including rest pauses, which was greater than the power averaged over an equal interval of continuous work.

Bilodeau [3] studied interpolated rest periods in a sprint cranking test using their heaviest resistive loading (No. 4 in Fig. 1) on the crank in the following fashion.

Five groups of 54 basic-trainee airmen each cranked as fast as possible. Each group performed ten 30-sec trials, and the groups differed in that rest periods of 0, 10, 30, 90, or 180 sec were interpolated after each trial for each different group. Data on power generated were obtained over 10-sec intervals of the work trials.

By computing the average power generated over the first 5 min for each condition, and plotting this average power against the percentage of time worked, it can be shown that continuous work is the most productive under these conditions.

Hick and Clarke [6] studied the rotation of cranks of 4.25-in. radius of rotation for both one and two-handed control in a tracking task. The authors were primarily interested in the loads which the operators could overcome before losing control in a tracking task.

Cranking Versus Control

With one-handed tracking, 12 young subjects of average physique were studied to determine the speed at which loss of control occurred. The speed of rotation demanded by the task was increased slowly so that power was generated at a fairly constant level for between 10 and 30 sec at the breakdown speed. The loss of control was manifest by lagging the target and then catching it by spasmodic efforts.

Fig. 2(*a*) presents the average power output measured under these conditions together with other data. The power was measured from the product of the average rotational speed and the frictional torque which was overcome. The speed at maximum power for these data was about 180 rpm. The approach to a constant slope of that portion of the power curve which extends to the origin represents the limitation on power generation

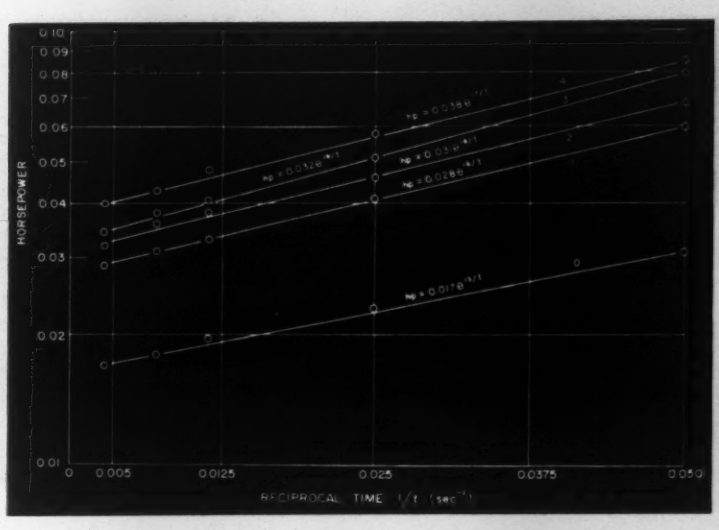


Fig. 1 Spring hand cranking. A performance decrement curve (adapted from Bilodeau and Bilodeau) replotted on a logarithmic scale vs. reciprocal time. Each data point is a combination of 50 subjects averaged over 20-sec intervals. The numbers 0, 1, 2, 3, 4 represent increasing resistive loads.

due to the maximum speed at which the subject can rotate his crank. This maximum speed of rotation was about 260 rpm.

We have plotted the Bilodeau data from Fig. 1 for the first 20 sec of cranking on the same plot, and it will be seen that these data are consistent with the data of Hick and Clarke.

It is of interest to note that Hick and Clarke, the Bilodeaus, and Katchmar each used a cranking axis at right angles to that used by the other two experimenters. Nevertheless, all their data fall on the same line in Fig. 2. Thus position effects are of minor importance for small cranks. Findings by Reed [7] for cranks of radii between 0.8 and 2.8 in., and very light loads, indicate that whether the cranking be clockwise or counterclockwise is also relatively unimportant for small cranks.

Cranking Through Large Radii

Power generation by cranking through larger radii was investigated by A. E. Hickey of the Electric Boat Company [8]. His apparatus consisted of a crank mounted to rotate in a vertical plane at the edge of a sturdy table. The crank axis of rotation was 36 in. from the floor, and the crank radius of rotation could be set at either 9 or 12 in. The 9-in crank was turned counterclockwise and the 12-in. crank was turned clockwise. A Prony brake supplied the resistive torque. The subjects were naval ratings who stood in front of the crank and rotated it as fast as possible.

Each subject usually made two trials, one for a total of 20 turns and a second trial for a total of 30 turns, for each value of the torque loading on the crank. In only one case was the time duration for the 30-turn trial as high as 40 sec. In all the other cases the duration was close to 20 sec for the 30-turn session. Since the power generated in the 20 and 30-turn trials was about equal, they were averaged together. Between four and ten trials were averaged for each data point. Some of the subjects were used for different crank loadings, but only the sturdiest subjects were capable of operating under the heaviest loads.

Fig. 2 presents Hickey's data up to the point where the subjects spontaneously shifted from one to two-handed cracking. On the assumption that this point represented maximum effort power generation for the crank used, Hickey's data was extrapolated to intercept zero at an estimated force loading. Two-handed-cranking data, through the small radius of 4.25 in., as obtained by Hick and Clarke, are also shown in Fig. 2(*b*). For these data, maximum power occurs at 140 rpm, and the limiting speed of rotation is about 210 rpm.

Types of Motions

In order to obtain information on the types of motions permitting the greatest velocity and horsepower for the design of tools, jigs, work methods, and so on, Koepke and Whitson [9] conducted an experiment on six men whose ages varied from 21 to 30. Six different weights—6, 9, 12, 15, 18 and 21 pounds, respectively—were accelerated by the subjects using six types of right-hand motions. The motions were:

1 *Long forehand sweep* from right to left with the arm extended.

2 *Long backhand sweep* from left to right with the arm extended.

3 *Short forehand sweep* from right to left with the forearm only, the elbow being held at the side.

4 *Short backhand sweep* from left to right with the forearm only, the elbow being held at the side.

5 *Forward thrust* of the right arm from a position at the right side of the body.

6 *Pull* of the right arm toward the body from an extended position of the front of the body.

Determinations were made of the time history of the velocities attained and the useful power expended by each of the subjects.

The general findings are as follows:

1 The variability between subjects was considerable.

2 The maximum instantaneous horsepower is dependent on the type of motion but is not very sensitive to the weight moved in the range studied. Motion 6 provided the maximum averaged instantaneous horsepower of about 0.6 hp.

3 Averaging over-all subjects and motions, the

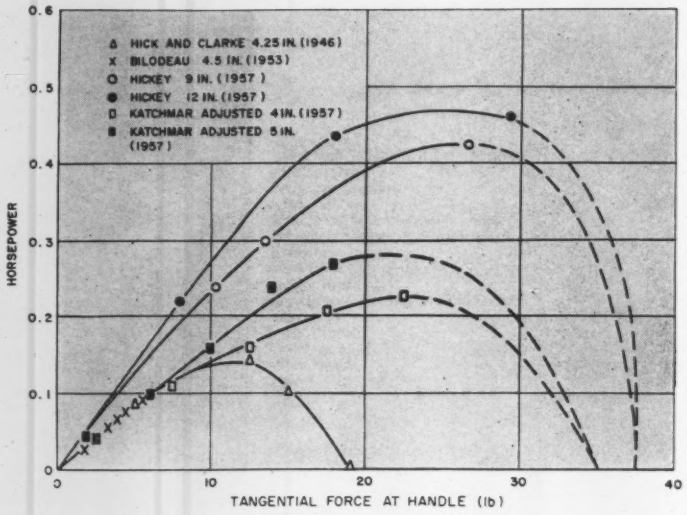

Δ HICK AND CLARKE 4.25 IN. (1946)
x BILODEAU 4.5 IN. (1953)
O HICKEY 9 IN. (1957)
● HICKEY 12 IN. (1957)
□ KATCHMAR ADJUSTED 4 IN. (1957)
■ KATCHMAR ADJUSTED 5 IN. (1957)
HORSEPOWER
TANGENTIAL FORCE AT HANDLE (lb)

Fig. 2 (a) Average power generated over short time intervals by one-handed cranking. Position effects are of minor importance for small cranks.

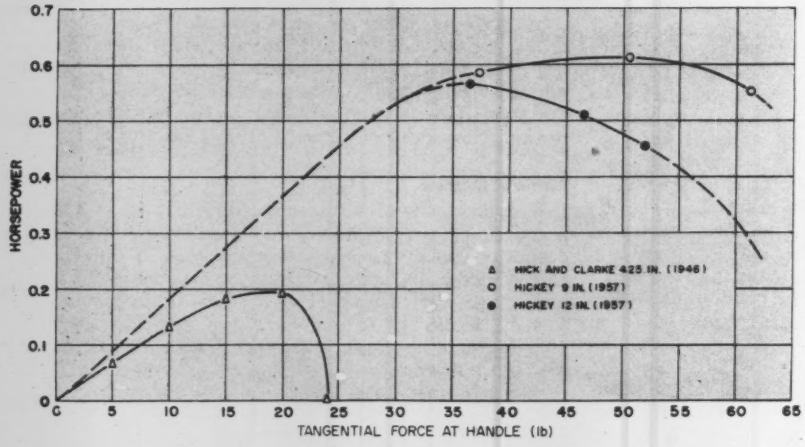


Fig. 2 (b) Average power generated over short time intervals by two-handed cranking. Maximum power outputs occurred at 80–85 rpm.

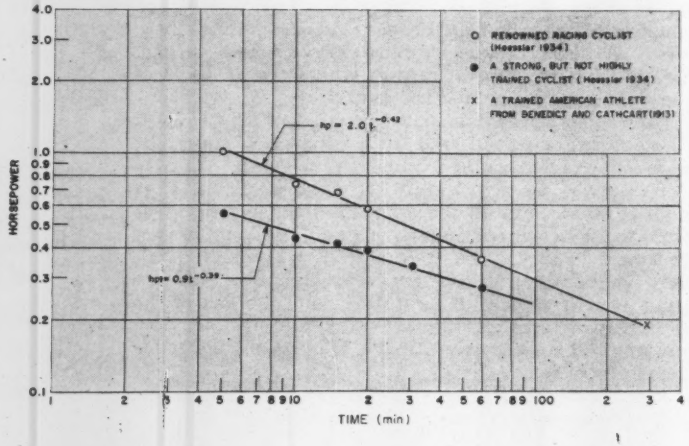

O RENOWNED RACING CYCLIST (Hoessler 1934)
● A STRONG, BUT NOT HIGHLY TRAINED CYCLIST (Hoessler 1934)
x A TRAINED AMERICAN ATHLETE FROM BENEDICT AND CATHCART (1913)
hp = 2.0 t^-0.42
hp = 0.91 t^-0.39
HORSEPOWER
TIME (min)

Fig. 3 Long-duration pedaling power. Because of their interest in muscle-powered flight, the Germans possess considerable data on pedal power.

maximum instantaneous horsepower is independent of the weight moved over the range studied and is about 0.5 hp.

The foregoing findings together with the data on the velocities achieved in each motion have been applied to production problems.

Pedal-Developed Power

The generation of power by a pedal-operated device is probably the technique with which we are most familiar. This method of power generation has been commonly used in bicycling for ground locomotion and uncommonly in muscle-powered flight for aerial locomotion. Difficulty in obtaining comparable data results from the multitude of variables which are associated with bicycling. In many cases, it is difficult to determine whether the task performed was maximum effort or self-paced. Since we cannot, in general, specify crank size, leg motion, average rpm of pedal, and so on, for the pedaling data, the data will be presented without comment.

During the 1920's and 1930's, about four and one-half centuries after Leonardo da Vinci designed an ornithopter, interest in muscle-powered flight flourished in Germany, France, Italy, and, to some extent, in the Soviet Union. Although both ornithopters and propeller-driven vehicles were studied, the propeller-driven vehicle appeared to be most promising. The essential function of muscle power was to prolong the flight of highly efficient gliders characterized by low sinking speeds (Raspet [10]; Ursinus [11]).

As a consequence of this interest in muscle-powered flight, there exists an arcane German literature on human power generation by means of pedaling as well as by means of handwheel rotation.

In Fig. 3, data presented by Haessler [12], without detailed comment, have been replotted with long-duration pedaling data from one of the Benedict and Cathcart [13] subjects, a trained athlete (M.A.M.) who pedaled the bicycle ergometer at a sustained effort for 4.5 hr.

Individual Characteristics

There are several remaining aspects of the problem of characterizing man-generated power; for example, motivation, individual differences, postural effects, and performance with respect to criteria other than power production.

In general, postural or position effects appear unimportant when relatively small amounts of power are generated, as with cranks of radii between 4 and 5 in. The comparisons in Fig. 2 bear out this point since the cranks compared were rotated about all three orthogonal axes. Although much work has been done with regard to the optimal positioning of larger cranks and wheels, the maxima about reasonable positions are fairly flat.

To be sure, large work decrements have been demonstrated for absurd positions of cranks, but common sense is about as good a guide as the data available. It appears to be true that the position of maximum force and endurance is also that position for which submaximal forces may be applied with least fatigue. The position of maximum force, however, is not generally equal to that position from which most precise control may be exerted or that position which is most comfortable, Darcus [15], Clark [16].

Backrests, harnesses, nonslip flooring—all contribute to greater power output by so positioning the operator that he may assume a favorable mechanical relationship with his machine without having to dissipate some of his own energy in maintaining this position.

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By Edward V. Somers[1] and John C. R. Kelly,[2] Westinghouse Research

Here is electrical energy produced directly from heat.

THERMOELECTRIC

For peaking, or emergency generation, the thermoelectric generator—with no moving parts—

THERMOELECTRIC power generation, long an exciting challenge, could introduce widespread changes into present methods of power generation by permitting generation of electric power directly from the heat of either conventional or nuclear fuels without the use of intermediate apparatus. Thermoelectric power generation may be attractive in applications where quietness, freedom from service difficulties, and design adaptability to any conceivable size or shape are important considerations. It may supplement existing methods of power generation by taking advantage of waste heat, or by operating as a topping unit ahead of the conventional apparatus at temperatures such equipment cannot withstand.

During the elapsed century and a quarter since Seebeck's discovery of thermoelectricity, little progress has been realized toward practical amounts of power, since known metallic thermocouple materials permitted maximum power-conversion efficiencies of less than one per cent—too low to offer promise of widespread commercial application. Only limited commercial use was found in the sphere of temperature-control devices. In recent years materials have been formulated with power-conversion efficiencies adequate to compete with many standard machines.

What Is Thermoelectricity?

It is necessary to have a basic understanding of the mechanism of thermoelectricity in order to compare it with conventional power generation. Fig. 1 represents a block of typical solid containing some free electrons. These can be made to move under the influence of either an electric or a thermal field. If heat is applied to one side of the solid, the electrons rearrange, becoming somewhat more sparse in the warmer regions of the specimen and somewhat more dense in the colder regions. This leads to the situation in Fig. 2, namely, an electrical gradient. To take advantage of this electrical gradient the circuit is closed externally and the electrons flow through the external circuit. In a complete thermocouple, Fig. 3, the effect is a pumping of electrons with heat. The electrons tend to flow to a region of lower density at all times and the flame preserves this region of lower density.

A more sophisticated explanation involves use of the "hole" concept where the current carriers in one arm of the couple are positively charged holes. Thus the *p* and *n* designations of semiconductor physics apply and the most efficient couples now and in the future will be based on a junction of such materials.

Contrast this pumping of electrons with heat with the present steam turbine where water molecules are pumped with heat to produce mechanical work which must be converted to electricity by the generator.

Governing Equations

The electrical power generated by the thermocouple junctions is split into a terminal output and an internal (I^2R) loss. There is also a heat-rate loss from the heat source by thermal conduction through the thermocouple. A merit factor to describe the thermocouple efficiency can be constructed proportional to the Seebeck coefficient and the hot-junction temperature and inversely proportional to the electrical resistivity and thermal conductivity of the thermocouple elements,

$$M = \frac{T_h}{4} \cdot \frac{S^2}{\rho\lambda}$$

where

S = Seebeck coefficient, volts per deg K
ρ = electrical resistivity, ohm cm
λ = thermal conductivity, watts per cm deg K

The efficiency of a thermoelectric generator is governed by the same basic considerations as those governing a turbogenerator. The thermal efficiency is related to the turbine-cycle efficiency and the electrical-generator efficiency by

$$E_{\text{thermal}} = E_{\text{cycle}} \times E_{\text{generator}}.$$

In a thermoelectric generator the E_{cycle} is the Carnot-cycle efficiency referred to the hot and cold junctions of the thermocouple, and the $E_{\text{generator}}$ is equal to the merit factor defined previously; therefore

$$E_{\text{thermal}} = \frac{T_h - T_c}{T_h} \times M$$

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[2] Manager, Technology Department.

Condensed from Westinghouse Research Laboratories Scientific Paper No. 10-0509-3-P7, presented at the Winter Meeting of the System Planning Committee of the Pennsylvania Electric Association, February 15–16, 1960.

Laboratories, Churchill Borough, Pa.

POWER

may be the economic answer.

In the case of the steam-turbine generator the cycle efficiency is a function of the turbine-boiler-heat-exchanger complex and the electrical efficiency is a function of the generator and its windage, frictional, and resistive losses. In the thermoelectric generator the material serves as its own heat exchanger. The highest acceptable temperature is applied to the hot junction, and the heat which is not converted to electricity is exchanged at the cold junction. Resistive losses still exist and thermodynamics still control. But since the only moving parts are charged elementary particles, the analog of windage and friction is the resistivity term already considered. For the heat cycle the operation of stages in series in a turbine is analogous to materials in series in a thermoelectric generator. An increase in rpm of a turbine is equivalent to an increase of ΔT in a thermocouple in so far as power density is concerned.

Some of the more efficient power plants today are of 40 per cent thermal efficiency, made up of a thermodynamic-cycle efficiency of about 45 per cent and a generator efficiency of better than 95 per cent. In a thermoelectric generator much higher temperatures can be tolerated simply because there are no rotating mechanical stresses on the material. This permits cycle efficiencies of 70 per cent or higher. As for generator efficiency, 40 to 45 per cent is a reasonable forecast. Hence the thermodynamic-cycle efficiency is the more desirable feature of a thermoelectric generator and the electrical-generator efficiency is the more desirable feature of a turbogenerator.

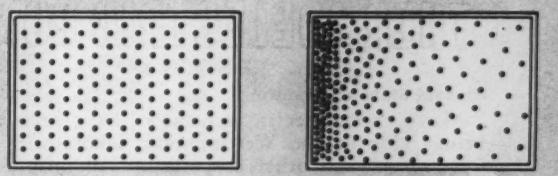
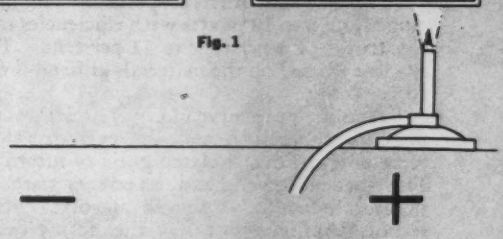


Fig. 1



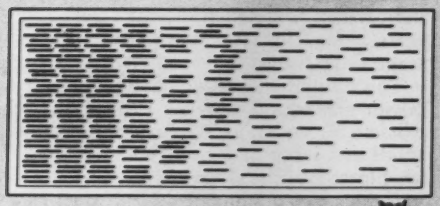


Fig. 2

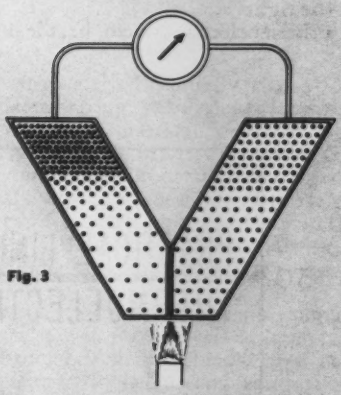


Fig. 3

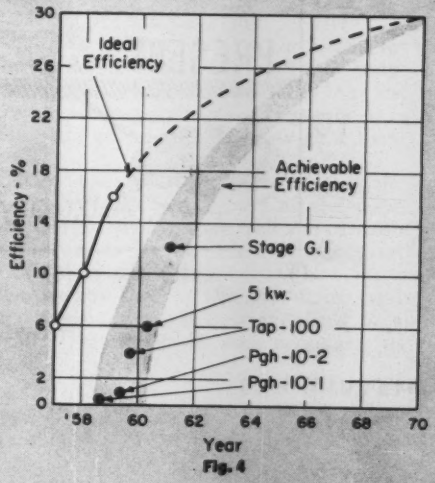


Fig. 4

Fig. 1 When heat is applied to one side of a typical solid containing some free electrons, the electrons rearrange, becoming sparse in the warmer regions and more dense in the colder parts

Fig. 2 This leads to the creation of an electrical gradient which can be utilized by closing the circuit externally and causing the electrons to flow through the circuit

Fig. 3 In a complete thermocouple, the effect is a pumping of electrons with heat—the electrons tend to flow at all times to the region of lower density preserved by the flame

Fig. 4 Accomplishments and future of thermoelectricity. Material capability is represented by the solid upper curve and an extrapolated guess by the extended dotted portion. The shaded area represents achievements and potential of generators—actual installations are represented by the large dots.

THERMOELECTRIC POWER

Present State and Future

Many thermoelectric generators have been and are being built in the Westinghouse laboratories and in government and other corporation laboratories in the range from 1 to 10^4 watts with efficiencies ranging from a few tenths of a per cent to 12 per cent. The calculated efficiency based on the materials at hand is of the order of 16 per cent.

The solid upper curve in Fig. 4 illustrates the maximum material capability, and the extended dotted portion represents the extrapolated guess of future development. The shaded lower band represents past, present, and immediate-future accomplishments; each generator represented by a dot has the design wattage rating indicated: (*a*) Pgh-10–1, 10 watts; (*b*) Pgh-10-2, 10 watts; (*c*) Tap-100, 100 watts; (*d*) 5-kw, 5 kw; (*e*) stage G.1, 1 watt.

The competitive value of thermoelectricity for various power-generation tasks is shown in Fig. 5, where the efficiencies under average-use conditions of auxiliaries, small and large prime movers, and central power plants are plotted. The slope of the curve is a function of three variables, two empirical and one exact. They are: (*a*) economy, (*b*) convenience, and (*c*) geometry. Geometry is the only exact criterion and refers to the well-known fact that the ratio of surface area (through which heat may be lost) to volume (which, as displacement, governs power) increases as smaller sizes are considered, leading to increasing inefficiency. The other two factors tend to depress the left side of the curve more than the right.

In a thermoelectric system, heat leak (into the thermoelectrically lined walls) is the only mechanism for power generation. Hence the factor which reduces efficiency in small conventional heat engines is inoperative. Furthermore, four couples give precisely twice the power output of two. This contributes to the conclusion that comparable efficiencies can be expected whether the generator is rated 1 watt or 1 mw. Thus all the area above the conventional power curve but beneath the present or limiting thermoelectric curve can be regarded as favorable to thermoelectric systems. That area common to both means of power generation must be decided on first cost and differences in maintenance cost which may be expected due to lack of moving parts.

There is an excellent possibility that, in the absence of moving parts, thermoelectric generators can be built at a lower cost than their conventional counterparts. Many short-time or intermittent operations such as peaking or emergency-generation conditions dictate that capital cost will be the predominant factor rather than heat rate.

With regard to prime movers the question of power density becomes paramount. In this respect more than in efficiency there is a long period of development ahead since the present values for thermoelectric systems are from 2 to 10 watts per lb. However, values ranging upward from 100 watts per lb have been calculated for the next generation of devices scheduled for the next two to five years.

Summary

Thermoelectric power generation is a simple and competitively efficient way to provide power for a number of small and intermediate loads. Efficiency of a thermoelectric plant, although not competitive with modern central power stations, may become sufficiently high to establish it as a useful peaking complement to a central power station.

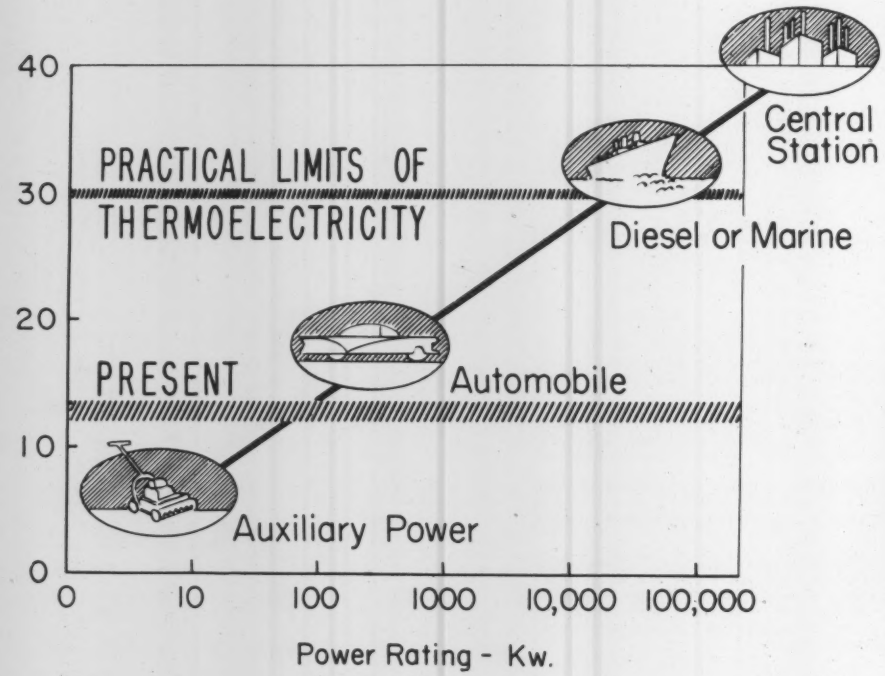


Fig. 5 Competitive value of thermoelectricity for various power-generation tasks—at present limited to auxiliary-power applications—is shown with average-use conditions, based on economy, convenience, and geometry

PHOTOELASTIC MODEL ENGINEERING

Photoelastic techniques as applied to the investigation of heavy machinery, using "stress freezing" and modern plastics.

By Herbert Becker[1] and George Gerard[2]

PHOTOELASTICITY is a method of experimental stress analysis in which the stress field in a structural model is made visible by means of polarized light. Although the method is old, analyses were restricted to plane-stress problems until the stress-freezing method was discovered in the late 1930's and was applied successfully to a variety of classical problems to establish its validity. However, investigations were limited in scope because large models could not be made from the small blanks of plastic then available.

With the introduction of epoxy resins and other new plastics in the late 1940's and early 1950's, the size limitation was removed. It became possible to make large models of complex shape by direct casting to reasonably close tolerances, or by cementing components together, or by some combination of these two methods.

The fringe pattern observed in a photoelastic model is interpreted in terms of stress with the aid of the calibrated model-material property termed the material fringe value, f. This is the amount of stress required to produce one fringe in a 1-in-thick calibration specimen. In addition to elastic modulus and ultimate tensile strength, body forces may become a problem in larger models, and consequently density is also a factor.

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Although a "figure of merit," actually the ratio of elastic modulus to material fringe value, has been evolved for expressing the value of a material for use in small planar models, it may no longer be satisfactory for complex shapes. The individual properties then become more important than a combination figure of merit. In short, the properties of modern photoelastic materials should parallel those of the prototype materials—good strength and elastic modulus combined with ease of formability.

The photoelastic properties of two of the more popular plastics now in general use in the analysis of large complex structures are summarized in Table 1. For comparison, data on Bakelite are included as representative of the older materials.

The data on Hysol approximate the properties of several epoxies, many varieties of which are available for current use. The Castolite data apply to a few polyesters, all of which appear to have an advantage over the epoxies in their resistance to time effect. However, it is possible to control this action in epoxies with a little effort.

Since the epoxies and some of the polyesters satisfy the need for a cementable plastic which retains the good photoelastic properties of the older materials and can also be cast, they are candidates for use in the experimental analysis of intricate heavy machinery.

There is now hardly any limit to the size, shape, and detail with which a structure can be reproduced in a photoelastic model. Previously it was necessary to

Fig. 1 The use of large photoelastic models of complex shape in which accurate machining is required is illustrated by a nuclear-reactor head. The completed head is a flanged hemispherical pressure vessel with a thickened-tube dome through which a penetration configuration is drilled.

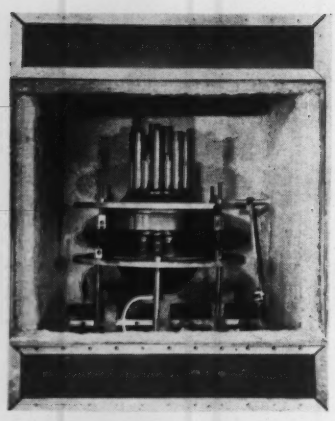


Fig. 2 The reactor-head photoelastic test assembly was stress frozen in an oven before test slices were excised for analysis of stress patterns

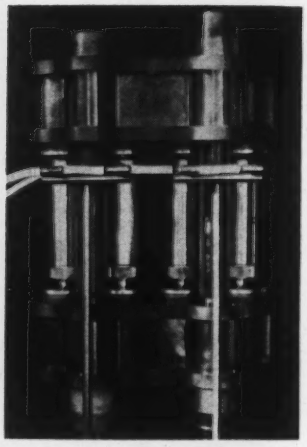


Fig. 3 A photoelastic model of a small forging press was constructed to study the stresses in several threaded-connection designs, and secondarily to investigate the crossheads. The cylinders in the crossheads were machined to the scaled-prototype dimensions.

select a small problem region of a structure for investigation—frequently with the sacrifice of some detail for the sake of a means of loading this excised component. It was also necessary to assume a loading distribution on the component in order to perform the investigation. Now it is possible to fabricate the entire structure and load it in the same manner as the prototype. Segments of the component in question can then be examined in detail and the stresses referred to the external loads without ambiguity. Since this is possible with any type of loading (including thermal loads), the scope of photoelasticity is now nearly limitless. However, the photoelastic investigator may now be required to conduct extensive engineering studies of the problem and of the model to be used.

Reactor Head. The reactor head, Fig. 1, demonstrates the use of large models in which accurate machining is required. The cementability of the plastic played an important role in the fabrication.

The completed head was a flanged hemispherical pressure vessel with a thickened tube dome through which a penetration configuration was drilled. The holes were of two sizes and the ligaments were small. The resultant tolerances between hole centers consequently were small, and the deviation across the entire model pattern was held to 0.001 in. The pattern was quite uniform.

The tubes were blind at their upper ends to contain the nitrogen used to pressurize the model. The tube seats were formed to match the curvature of the dome, to which they were cemented with a butt joint that had the structural continuity of a welded connection. These blind tubes then represented the connection between head and tube actually to be encountered on the prototype.

The pressure applied to the inner surface of the head was reacted in the prototype by a ring of bolts on the right edge of the flange, Fig. 1. On the model a simplified loading system was used, employing a steel clamping ring which acted through a soft gasket upon the upper surface of the flange thus insuring uniform distribution of reaction around the flange. A token sector of holes was drilled through the flange to ascertain the magnitude of the stress concentrations to be expected.

The head preload was specified from the prototype requirements in terms of the model pressure. It was reproduced on the model by means of four flexible springs that were calibrated before the test. The model pressure and preload were reacted by another head of simplified design which furnished the other half of the pressure cavity and also had the same relative structural rigidity as the shell of the prototype. The assembled test arrangement is shown in Fig. 2 in the oven before freezing.

Slices were taken from numerous locations for analysis of the model. The fringes in a ligament slice taken from the dome parallel to its upper surface are shown in the figure at start of article. The pattern shows maximum stress at the knuckle of the flange and shell. The mottling that exists in the flange region may be diminished as more experience is gained. It can be an annoying problem since it tends to distort the fringe patterns.

A preliminary stress analysis of reasonably good ac-

Table 1 Photoelastic Properties of Hysol 6000-OP and Castolite

		Young's modulus, psi	f, lb/in. per fringe	Ultimate tensile strength, psi	Castability	Cementability
Hysol 6000-OP	Room Temp	500,000	56	6000	Excellent	Excellent
	300 F	2400	1.4	350		
Castolite	Room Temp	705,000	158	8000	Good	Excellent
	245 F	4100	8.3	350		
Bakelite	Room Temp	600,000	86	17,000	Small plates only	Fair
	230 F	1100	3.2	400		

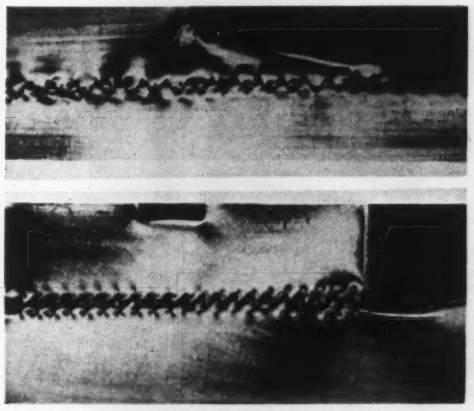


Fig. 4 Two basic threaded-connection designs were used. The original nut, **bottom**, was a uniform cylinder, while the modified design, **top**, involved a tapered skirt with a sleeve to act as a comparatively soft spring. The thread design also varied. The maximum stress occurred at the root of the first engaged thread in the original design, while the load was diffused by the sleeve in the modified design.

Fig. 5 A large forging press was built to a scale of 1:24. The photoelastic model reproduced all details faithfully, including machining of cylinders to scale and the use of hollow tie rods to convey the pressurization fluid to the cylinders. The model was actually operable as a 1-ton press before it was stress frozen and sliced for analysis.

curacy is important in large-model work in order to determine the optimum pressure to apply to the model. The maximum fringe order attainable would simplify the analysis of the data and increase the accuracy of the investigation, but too high a pressure would either crack the model or distort it severely during the stress freezing. The applied test pressure and the corresponding preload for the model were selected to generate a stress equal to 30 psi in order to minimize model deformations.

For the reactor head the two regions of principal interest were the knuckle and the dome ligaments. To determine a suitable test pressure, the model knuckle was analyzed theoretically as a cylindrical shell-ring structure with a local concentration factor taken from the literature for the radius of curvature of the outer knuckle contour. The dome was analyzed as a simple spherical shell with the ligament efficiency included in the stress calculations together with another concentration factor for the hole pattern. The experimental data, interestingly enough, yielded stresses which were within 10 per cent of these values.

This discussion highlights the feature of complex-model photoelasticity that has seldom arisen in the past. Each model investigation is in itself an engineering project. Because of the cost of a complex model and the required manufacturing time, it is necessary to insure the highest possible fringe order that will not cause failure or excessive deformation of the model. This implies a thorough knowledge of stress analysis and a sound background in developing procedures to apply loads correctly and to measure them accurately.

Forging Press. The photoelastic model of the small forging press, Fig. 3, was built to study the stresses in several threaded-connection designs, and secondarily to investigate the crossheads. In order to represent the structural behavior of the crosshead in the prototype press, the cylinders in the crossheads were machined to the scaled prototype dimensions.

The press was loaded by four calibrated cylinders using nitrogen gas as the activating fluid. The entire structure was supported by crossarms on each loading cylinder, which acted on the crosshead through spherical bearings.

Different connection designs were used at the ends of the tie rods, Fig. 3. The symmetric crosshead arrangement was used since the remainder of the press was not of interest at that time. Furthermore, the crosshead deformations would have been little influenced by the additional press structure, and consequently the stress distributions in the threaded connections were expected to be representative of the prototype behavior.

Two basic threaded connection designs were used, with variations on these designs to test additional factors of interest. The original nut was a uniform cylinder while the modified design involved a tapered skirt with a sleeve to act as a comparatively soft spring between the seat of the skirt on the nut and the face of the crosshead on which the nut sits. In addition, the thread of the original design was a sharp-cornered buttress while that in the modified nut was a slight variation of a standard V. The fringe patterns obtained with the two designs appear in Fig. 4.

The effect of the collar on the modified design was determined by measurements of the deformations in the press assembly before it was dissembled for photoelastic analysis. These deformations revealed that the tie rods on the original connection rotated very nearly in unison with the local rotations of the crosshead face on which the nuts bore, whereas the tie rods of the modified design rotated considerably less than this. The measurements of the stress-frozen press which permitted this comparison were made with ease with a standard vernier caliper.

The crosshead investigation was principally qualitative. There was considerable disparity between the stresses and deformations obtained, compared with those computed by elementary beam theory. The crosshead deformations were obtained using a surface plate and a dial indicator to traverse the faces upon which the nuts bore. A saddle-shaped pattern was clearly defined. In addition, the load path could be surmised from this study. It indicated that the cylinders on each side of a pair of tie rods at each end of the press represented a self-

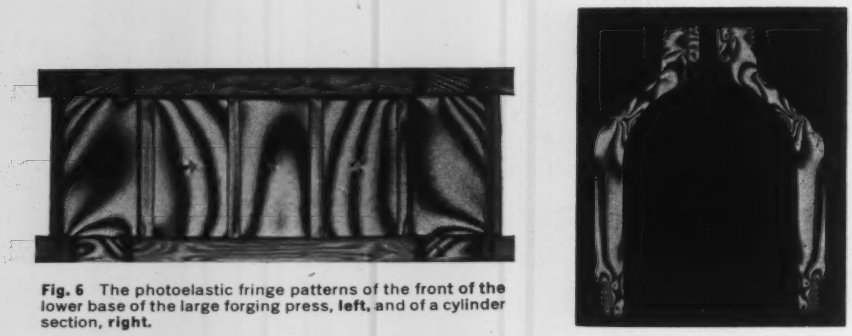


Fig. 6 The photoelastic fringe patterns of the front of the lower base of the large forging press, **left**, and of a cylinder section, **right**.

reacting system of four parallel forces with the internal crosshead ribs and the crosshead plate providing the paths between loads. The structural action was therefore primarily shearing of the ribs and local deformation of the plate instead of beam action involving the entire crosshead section. This problem was investigated in further detail in the next project.

Large Forging Press. Because of the complexity of the large forging press, Fig. 5, it was decided to perform a photoelastic investigation of the entire structure for comparison with the anticipated performance as predicted by the theoretical analysis. The press was built to a scale of 1:24 with all details reproduced. The faithfulness of the reproduction included the use of hollow tie rods to convey the pressurization fluid to the cylinders, and the machining of the cylinders accurately to scale. The only departure was the use of a metal plunger and special seal instead of a plastic system since an extensive study showed the latter to be unworkable. Completed model actually was operable as a 1-ton press.

The model was stress frozen by introducing nitrogen gas pressure in the cylinders. Previous calibration of each cylinder before test showed uniformity of response (pounds force per psi pressure) within 2 per cent. A check of the concentricity of loading with the frozen pattern in the central die and symmetrical platens revealed negligible deviation from side to side.

In the analysis of the model it was necessary to correct the photoelastic stresses in each crosshead for the weight of the press model which bore upon it. The limiting factor was the modulus of elasticity for the epoxy. The ultimate tensile strength was large enough to permit greater loading than was used, but stretching of the tie rods would have exceeded piston stroke in the cylinders.

After the stress freeze, the model was sliced for analysis. Typical patterns depict the stresses in the outer wall of the lower base and in a section of one of the cylinders, Fig. 6. The small holes in the base wall were drilled to avoid pressure buildup of the entrapped air in the cells. The structure was formed, as were all of the crossheads of the press, by casting each rib structure in one piece and then cementing the upper and lower plates, after which the crossheads were machined to final shape.

This freedom of manufacture is relatively simple with the epoxies since they lend themselves to the casting of a complex ribbed structure in which there is no draft on the walls, while the faces are reasonably clear and polished. However, it is necessary to develop good manufacturing technique and molding facilities in order to produce such a complex casting as a crosshead. In other words, engineering is also required in the casting of the model components in order to achieve the desired tolerances in a precision part.

Equipment

Large complex photoelastic models for machine-design studies entail the use of equipment for fabrication and test which has not been required in photoelastic studies in the past. Plastic blocks may now be cast in the 100-lb range. Boring machinery and lathes with a swing of 15 in. or more are now in use. Furthermore, the ingenuity of the machinist is taxed severely by the demands of special tools required to manufacture each new model.

A well-fitted machine shop is needed for complex models and a large oven is necessary for stress freezing. The convective oven used by the authors has a useful chamber space 5 ft sq by 6 ft high. A complete nitrogen piping system is integral with the oven, which has a rugged floor to accommodate heavy models and mechanical-loading systems.

The large-field polariscopes (15 to 18 in.) required are available in many photoelastic laboratories.

Summary

The minimization of uncertainties in loading and restraints on models of structural components has always been a problem. Since it is now possible to fabricate models of extreme complexity and considerable size, there is no longer any need to sustain these uncertainties. Furthermore, the process of model engineering is effectively a repetition of part of the prototype design procedure. Therefore inclusion of the photoelastic investigation of a fully scaled model during the design stage is almost a natural step and has been used in the design of several nuclear power plants.

Acknowledgments

The reactor-head investigation was performed for the Foster Wheeler Corporation while the two forging-press models were analyzed for Engineering Supervision Company. Houghton Laboratories supplied the 6000-OP epoxy castings from which these structures were made.

Bibliography

NOTE: The use of epoxies for photoelasticity began in England. One of the first reports was by Spooner and McConnel [1]. Recently Leven developed a form which Westinghouse has been employing in extensive studies of pressure vessels [2]. The first known application of a polyester, Paraplex, was reported by Williams [3] while Frocht and Pih described the properties of Castolite [4] which is similar to Paraplex.

1 H. Spooner and L. D. McConnel, "An Ethoxylene Resin for Photoelastic Work," *British Journal of Applied Physics*, vol. 4, June, 1953, pp. 181–184.

2 M. M. Leven, "Recent Trends in Photoelastic Plastics," *Modern Plastics*, vol. 34, May, 1957, pp. 151–155.

3 M. L. Williams, "A Review of Certain Analysis Methods for Swept-Wing Structures," *Journal of the Aeronautical Sciences*, vol. 19, September, 1952, pp. 615–624.

4 M. M. Frocht and H. Pih, "A New Cementable Photoelastic Material," Illinois Institute of Technology Report to the Office of Ordnance Research, May, 1953.

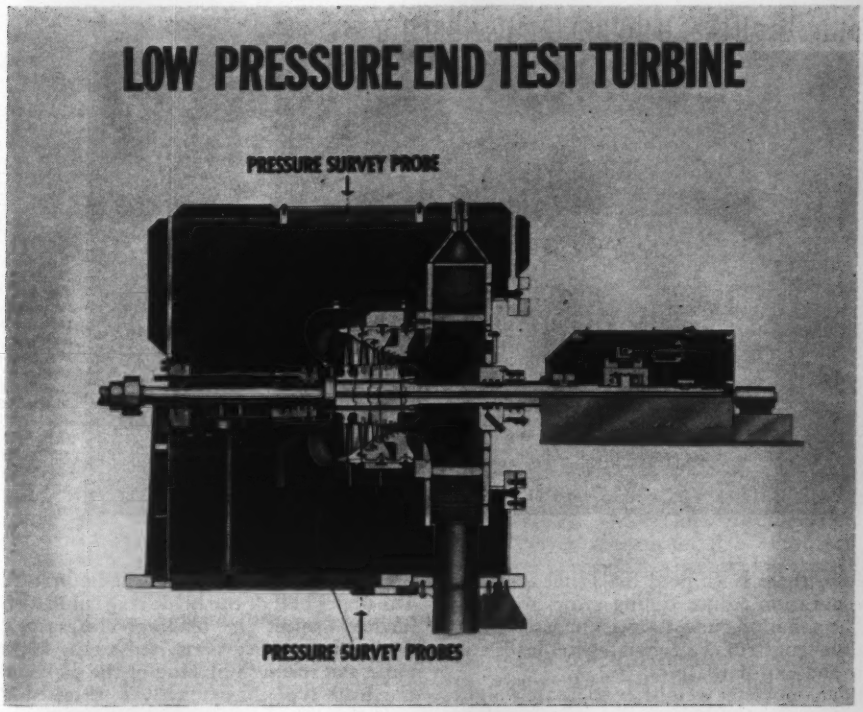


Fig. 1 A factor of 0.435 was used in scaling down the standard l-p element of a 100,000-kw, 3600-rpm, single-flow turbine with a 23-in-long last-row blade. Sufficient variation was thus possible within the limits of the laboratory steam-supply and power-absorption facilities. Dotted lines in the inlet chamber, in this longitudinal section, represent multiple screens which establish uniform flow conditions before the first stage. The cover can support internally any blade-path and exhaust-hood arrangement without a flanged connection to the condenser, since the exhaust hood is not a pressure vessel and merely serves to guide flow at the exhaust of the turbine blading.

A TURBINE-TESTING FACILITY

The design philosophy, features, and instrumentation of a low-pressure steam-turbine test facility. Small changes in design can be evaluated only if efficiency can be determined with a high degree of accuracy.

By C. A. Meyer,[1] C. E. Seglem,[2] and J. T. Wagner,[3] Westinghouse Electric Corporation, Lester, Pa.[4]

THE principal purposes of the l-p turbine facility to be described were accurate-as-possible measurement of: (*a*) The turbine efficiency, including moisture and Reynolds number effects; (*b*) the blade vibratory stresses, damping, and exciting forces; (*c*) the exhaust-hood losses and the effect of the hood on blade vibration; (*d*) the effectiveness of moisture-removal devices; (*e*) the spindle end thrust.

The accuracy with which the efficiency is measured fixes the magnitude of the smallest improvement that can be added with certainty. If accuracy is within a half a per cent, no smaller improvement can be demonstrated with reasonable certainty.

Since efficiency is defined quite arbitrarily, the definition should permit quick and accurate determination in terms of simple measurements. Extensive flow traversing, or similar measurements, should be avoided since they jeopardize the quick and accurate determination of incremental changes in efficiency.

Among the items involved in the determination of efficiency, the accuracy of torque and flow measurement both depend on a standard-force measurement. Dynamometer weights can be calibrated by weighing them on flow-weighing scales and eliminating the uncertainty in the force standard. Similarly, if the time interval for counting revolutions is identical with the time interval

[1] Advisory Engineer. Mem. ASME.
[2] Supervisory Engineer. Assoc. Mem. ASME.
[3] Development Engineer. Assoc. Mem. ASME.
[4] Steam Division.

Contributed by the Power Division and presented at the Annual Meeting, Atlantic City, N. J., November 29–December 4, 1959, of THE AMERICAN SOCIETY OF MECHANICAL ENGINEERS. Paper No. 59—A-88.

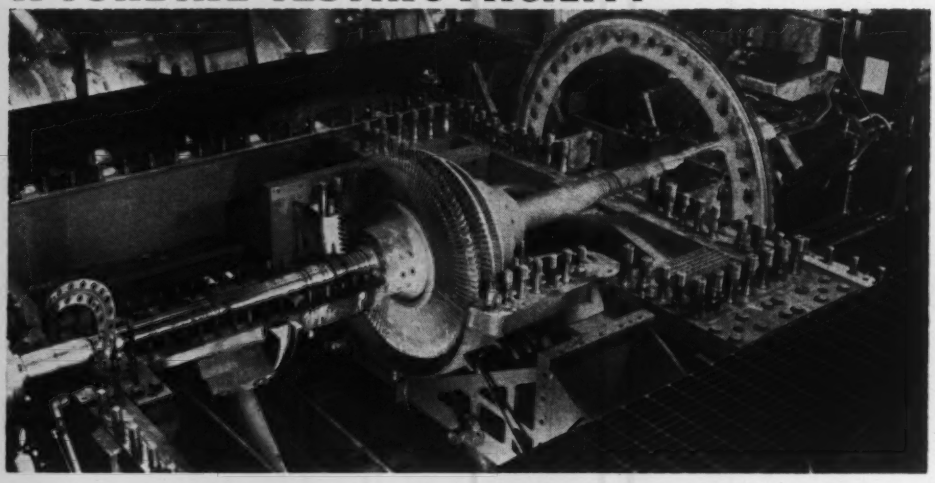


Fig. 2 The base section of the test facility during assembly, with the spindle in place. The turbine output is absorbed by a 3000-hp, 10,000-rpm disk-type water brake.

for weighing flow, there is no need for a time standard. Tests of 20-min duration reduce timing errors to a very small value. The remaining uncertainties in determining efficiency are in the length of the dynamometer lever arm, and in the inlet and exit enthalpies.

The values of dynamometer weight, condensate weight, brake-lever-arm length, and the number of revolutions can be measured with small uncertainty. The value of inlet enthalpy is most accurately found from pressure and temperature measurements in a large plenum chamber where velocity effects are small and a large inlet chamber with a well-rounded, low-loss entrance nozzle into the blade path was used.

The isentropic blade-exit enthalpy is the most difficult measurement to make due to the large exit area with its variation in mass flow, total and static pressure, flow direction, and temperature. The exit annulus should be surveyed with traversing instruments. In the detemination of isentropic enthalpy at the outlet the pressure measured at the exit of the exhaust hood leads to a more accurate flow-weighed value since the pressure is more uniform and the velocities are smaller. Incremental changes in efficiency can evidently best be measured using the hood exhaust-pressure measurement to calculate the over-all efficiency.

Separation of hood losses from the blade-path losses is less certain. A circumferential traverse is used at the blade-path exit. Individual-stage losses obtained by interstage traverses are also approximate.

With these considerations, increments in the over-all efficiency can be measured to within $\pm 1/4$ per cent, while the absolute level of efficiency is within $\pm 1/2$ per cent. Interstage traverses of flow angle, velocity, and similar measurements serve to indicate the approximate regions of further improvements in turbine design.

The basic mechanical arrangement of the present test facility is derived from a multistage turbine tester built in 1930[5] which has performed well. The base of this contained the bearings and the inlet and outlet steam connections. An easily removed cover revealed the stationary blade ring and the spindle in its tested condition. The upper half of the blade ring could also be removed to further inspect the blading, clearances, and so forth. Wide adaptability permitted single and multistage impulse and reaction blading of the disk and diaphragm or the drum-type construction to be tested.

The present facility was arranged with a cover which could support internally any blade-path and exhaust-hood arrangement, permitting various exhaust-hood forms to be tested without a flanged connection to the condenser. The test hood is not a pressure vessel but merely serves as a flow guide.

Measurement of spindle end thrust as a by-product of the efficiency test is provided. This was lacking in the old facility. Bearing losses can be measured directly, making unnecessary the special loss tests in which the turbine was driven through a torsiometer.

The Test Facility

A single-flow turbine, scaled from a standard l-p element of a 100,000-kw 3600-rpm turbine with a 23-in-long last-row blade, was built as the first test model in order to establish the basic performance level of l-p turbines of company-standard design, Fig. 1.

The scale factor of 0.435 allows sufficient variation in test conditions within the limits of the laboratory steam supply and power-absorption facilities. Even so, the six stages can develop as much as 15,000 hp when the turbine is operated at full-scale Reynolds number, brought about by doubling the pressure level and holding volumetric flow constant. The model speed is scaled to 8280 rpm. Manufacturing problems were challenging, particularly for the scaled turbine blades since all tolerance allowances decrease directly with the reduction in size. The bladed rotor (last three stages only) of the model turbine exactly duplicates the familiar picture of a typical l-p turbine spindle, Fig. 2. Only the last three stages have been tested to date since these represent the complex design problem.

The base section of the test facility with the spindle in place is shown in Fig. 2. By means of multiple screens, the inlet chamber allows uniform flow conditions to be

[5] A. Egli, "Flow Characteristics of Variable-Speed Reaction Steam Turbines," *Trans. ASME*, vol. 58, 1936, pp. 7–11.

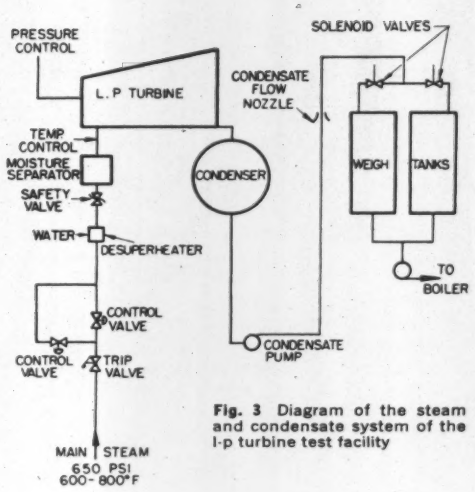


Fig. 3 Diagram of the steam and condensate system of the l-p turbine test facility

established before the first stage in order to carefully determine the state point of the incoming steam, Fig. 1. Versatility is a keynote of the facility. The bolted-rotor construction allows easy addition, removal, or replacement of any stage. The outer-casing design allows great freedom in exhaust-hood variation including use of an axial-flow exhaust. Changes in turbine blading can be carefully evaluated under turbine-operating conditions.

Great care and planning went into thermodynamic-data instrumentation since this basic laboratory facility will furnish the absolute performance level of l-p turbine blading, and eternal vigilance is necessary for accurate and reproducible results.

Automatic pressure-reducing valves and an automatic desuperheating station are the main elements in the control of the steam supply to the turbine over a wide range of closely held conditions of pressure and temperature, Fig. 3. The primary inlet-state point is determined by five independent measurements of total pressure and total temperature in the turbine-inlet chamber. Water can be sprayed into the inlet chamber through a spray-nozzle arrangement to increase the moisture level in the turbine stages, if necessary. Sealing steam for the shaft seals is supplied through a separate system. By using pressure-balanced seals, the gain or loss of turbine-blade-path steam is kept to a very small and insignificant value.

The condensate-handling system, Fig. 3, is served by a 12,000-sq-ft condenser. A calibrated weigh tank is the primary means of determining turbine flow. The hot-well level is maintained at all times. Determination of the turbine-flow characteristic number for a given geometry allows the test engineer to check the consistency of the flow, inlet-pressure, and inlet-temperature measurements during any test run.

The turbine output is absorbed by a 3000-hp, 10,000-rpm, disk-type water brake, Fig. 4. A hydraulic load cell transmits the reaction of the brake to a precision gage, calibrated to read torque directly. The torque system is calibrated daily before and after turbine operation. The same weights are used to calibrate the flow weigh tank. The brake performance has been outstanding. Power absorption has been very stable and no significant erosion has occurred in about 1000 hr of operation. Loads as high as 4500 hp have been carried at 8280 rpm with ease.

Lube oil for the four journal bearings and the thrust bearing is supplied through calibrated flowrators, and the temperature rise of the oil across each bearing is measured by thermocouples. Knowing the oil-flow rate, the hp loss through the bearings can be calculated and added to the brake output to determine the turbine work. The thrust-bearing pedestal is designed so that both the axial force and the torque developed on it by the turbine can be measured with calibrated load cells. The torque is used to calculate the thrust-bearing loss, as an independent measurement of the major bearing loss.

The lube-oil system also furnishes control oil pressure for the main-steam trip valve and the series of limit switches which protect the turbine against emergencies such as overspeed, low bearing-oil pressure, overtemperature, low brake-water supply pressure, loss of vacuum,

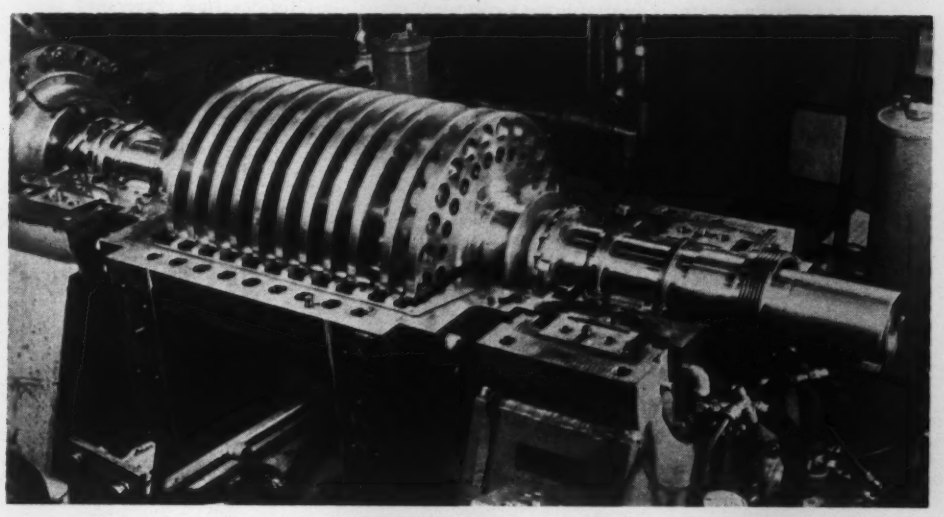
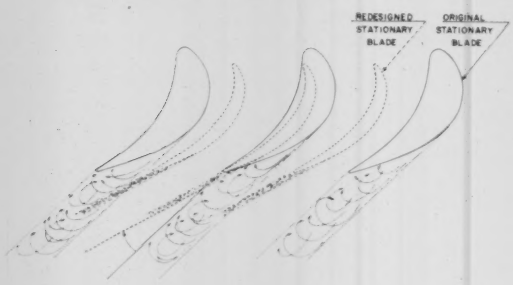
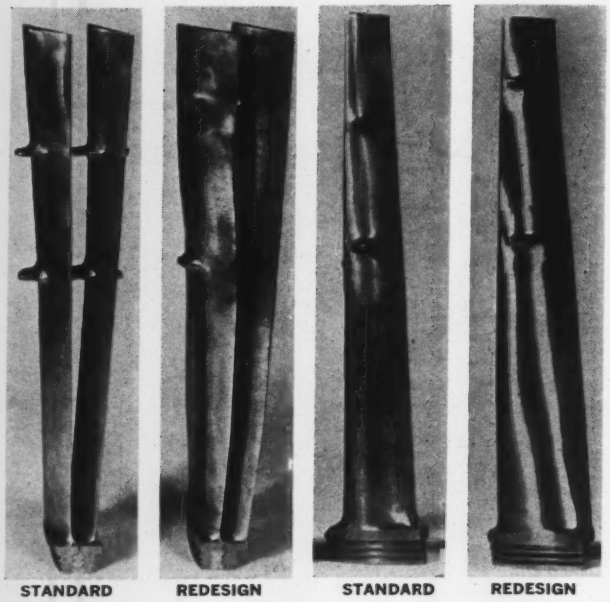


Fig. 4 The disk-type water brake's reaction is transmitted by a hydraulic load cell to a precision gage calibrated to read torque directly. Loads as high as 4500 hp have been carried at 8280 rpm with ease.

Fig. 5 Below As a result of performance tests, the stationary blades in the last two stages were redesigned to an airfoil section of closer-pitched design with a marked improvement in performance

Fig. 6 Right A comparison of the original and redesigned blading for the last two stages of the l-p turbine model





and other exigencies. During performance tests, the turbine uses no governor in its operation and speed control is achieved by setting steady conditions of flow, inlet temperature, vacuum, and brake torque. Reliable performance data can be obtained only when all of these quantities are steady, and the speed then is also steady within ± 20 rpm. New designs of electric governors, both analog and digital types, are used on the turbine during blade-vibration tests, and will hold speed even more closely through control of the brake torque. Speed is measured by three independent systems—a tach-generator mounted on the pedestal, and two electronic counters which receive their signals from magnetic pickups facing separate gears on the shaft.

Thermodynamic Instrumentation

To provide the detailed thermodynamic knowledge required for improved l-p turbine design, extensive traversing of the turbine-blade path and exhaust hood measures total pressure and temperature, static pressure, and flow angle.

Starting at the turbine-model exhaust-hood flange in Fig. 1, a traversing system is available for a complete map of pressure and mass-flow distribution leaving the turbine. The exhaust hood itself can be traversed with probes at many points to determine flow and pressure distribution within it, and study the complex nature of the hood loss. The turbine-exhaust annulus can be traversed with radially moving probes just downstream from the blades, at five points around the circumference. In addition, a probe assembly rotatable both about its own axis and the turbine axis permits full exploration of 360 deg of the annulus in any desired increments of circumference. This remotely controlled probe has five fixed radial stations for determining total pressure and temperature, static pressure, and tangential (swirl) flow angle. Thus an accurate flow-weighted average of leaving energy and exhaust-hood pressure losses can be obtained. Each interstage plane of the blade path can be traversed along radial lines at fixed circumferential locations for these same physical quantities. Most of the probes are wedge-type because of compactness and consistency over a wide operating range. Every probe is individually calibrated, and all probe tubing is air purged to avoid possible water-leg errors during a traverse.

This detailed traversing is very time-consuming but is the only way in which the flow field of an actual turbine

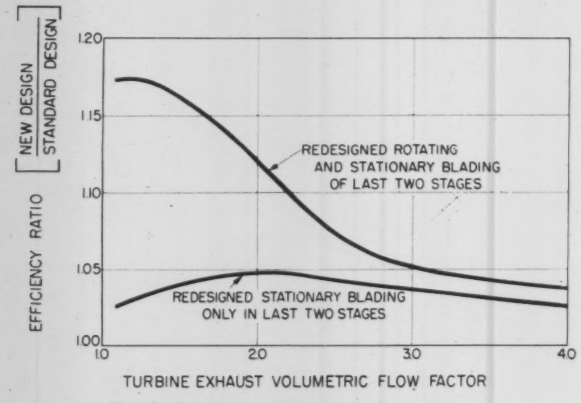


Fig. 7 Relative performance of the redesigned blading for the last two stages of the l-p turbine-model test facility

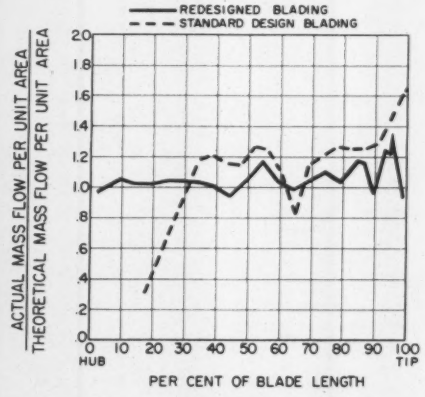


Fig. 8 Comparison of the mass flow distribution in the turbine exhaust annulus for standard and redesigned blading

and an individual stage can be compared in detail with the theoretically derived flow field. Traverse data are processed on an electronic digital computer for thermodynamic and blade-vibration data. The interacting effects on the probe readings of the swirl angles, radial flow, probe calibrations, and the geometry of the probe in the turbine are considered. Streamlines in the blade path are obtained by an iterative process. Such experimental results permit refinement of the theoretical method, and as a more complete knowledge of the complex flow field of an l-p turbine is obtained, it is possible to redesign for improved performance.

There is provision for study of moisture-removal methods, and the effect of blade-path moisture on turbine performance. The design and location of slots for extracting steam for feedwater heating, the quality of the extracted steam, and the effect of the extracted flow on the following stage can be evaluated under controlled test conditions.

Thermodynamic-Test Results

Two major performance-test programs have been completed. The first involved the accurate determination of performance level of standard-type blading. The standard-blade path was then modified by changing the stationary blades in the last two stages to a redesigned airfoil section of closer-pitched design, Fig. 5. Supplementary information to support this design change was obtained with field traversing in operating l-p turbines of company design. This was performed in power stations through the excellent co-operation of the Philadelphia Electric Company, Baltimore Gas and Electric Company, Public Service Electric and Gas Company, Duquesne Light Company, and the Tennessee Valley Authority.

The second major performance-test program involved the determination of performance level of redesigned blading, both stationary and rotating rows, for the last two stages of the l-p turbine, Fig. 6. Much analytical work preceded design. The electric tank analog[6] and high-speed digital computers were extensively employed. The redesigned stages are completely interchangeable with existing turbines.

Comparative performance, shown in Fig. 7, indicates a

[6] R. P. Benedict and C. A. Meyer, "Electrolytic Tank Analog for Studying Fluid-Flow Fields Within Turbomachinery," ASME Paper No. 57—A-120.

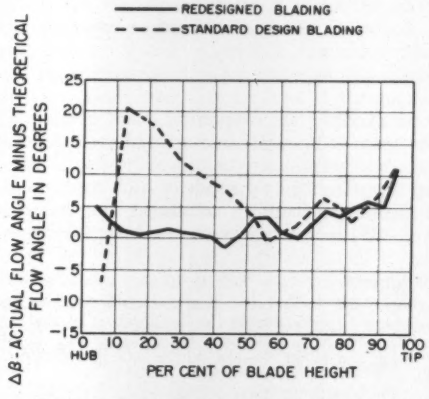


Fig. 9 Comparison of the relative flow angle leaving the last rotating row as determined by traverse

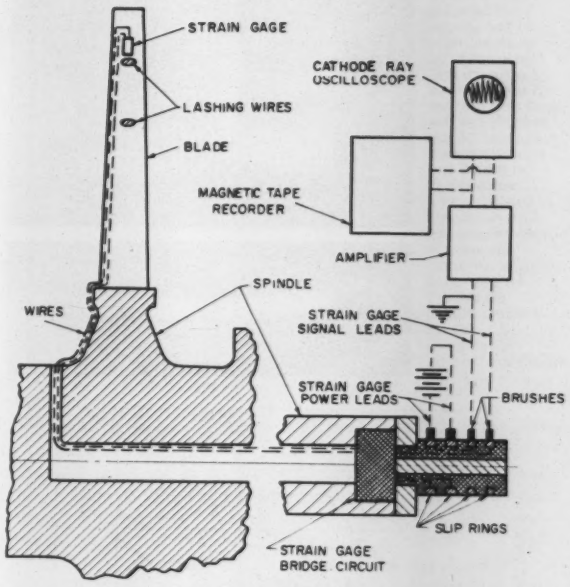


Fig. 10 Schematic diagram of the strain-gage instrumentation for the l-p turbine test facility

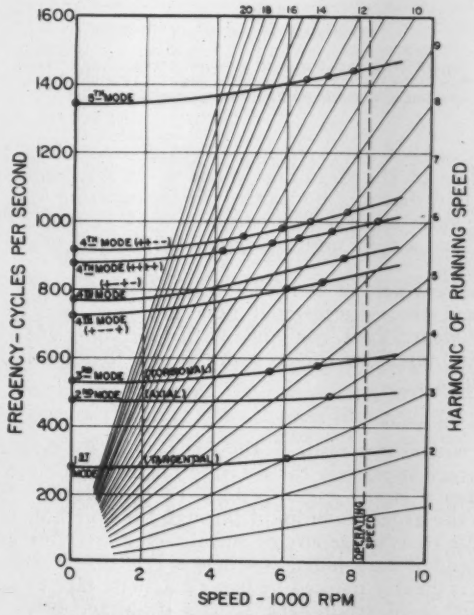


Fig. 11 The resonant vibrations detected in one lashed group of last-row standard-design blades in the model of the 23-in. blade

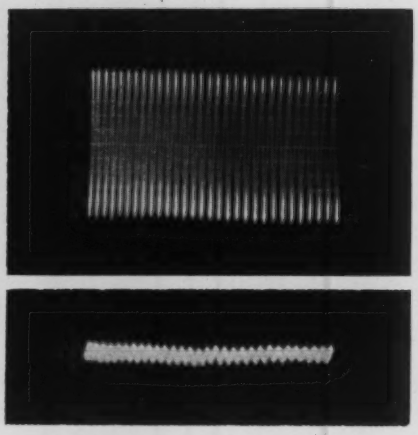


Fig. 12 Oscilloscope photographs of the strain-gage signals. The amplitude is proportional to blade stress and the number of cycles is the harmonic of the running speed at which the vibration is occurring. The 30th harmonic nozzle resonance vibration is shown in **(a)** for standard stationary blades, and in **(b)** for redesigned stationary blades.

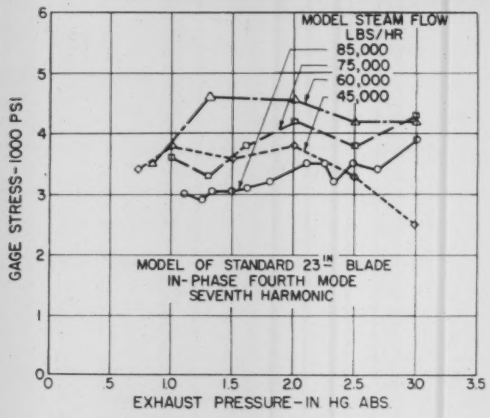


Fig. 13 The variation with exhaust pressure and mass flow of the resonant stresses at a gage on a standard last-row blade, under conditions described in the text

rather marked improvement. Typical results from traverse data are shown in Figs. 8 and 9. A much more uniform flow distribution leaving the last rotating row, and hence more uniform distribution of work along the blade exist, and a more uniform value of relative flow angle is obtained.

The flow field of an l-p turbine is an exceedingly complicated three-dimensional flow problem. Exhaustive experimental data, combined with continuing analytical studies, represent the stepping stones to improved l-p turbines.

Blade Vibration

Provision was made in the test facility for measuring vibratory stresses in the rotating blades with electrical-resistance strain gages bonded to the blades. Wires from the gages are brought through the bore hole in the spindle to a bridge circuit and slip-ring assembly at the inlet end of the spindle, as shown in Fig. 10. The testing time is greatly reduced by using magnetic tape to record a number of strain-gage signals simultaneously. The signals can then be carefully examined during shutdowns and after completion of the test.

Vibratory stresses in the last row and next-to-last row of rotating low-pressure blades have been measured over a wide range of turbine speeds and flow conditions. Fig. 11 indicates the resonant vibrations detected in one lashed group of last-row standard-design blades in the model. Resonance occurs when a natural frequency of the blade group, denoted by a mode line, is an integral multiple (harmonic) of the turbine running speed. Harmonics are denoted by the radial lines. Resonant vibrations are therefore possible at turbine speeds at which these lines intersect. Centrifugal effects cause the natural frequencies to rise with running speed. The plus and minus signs indicate the phase relationships of the tips of the blades in a group. Blades are designed to avoid resonance at operating speed in the tuned modes. This blade has been tuned in the three lowest frequency modes.[7]

High stresses were observed when standard-design rotating blades in the last row were resonant with the stationary-blade-passing frequency (nozzle resonance). This is probably the first experimental evidence that this phenomenon is important in long, low-pressure blades. The frequency of this vibration is high, corresponding to approximately 1800 cps in a full-size machine. Photographs of the strain-gage signals on an oscilloscope are shown in Fig. 12. The amplitude of the signal is proportional to blade stress, and the number of cycles displayed is the harmonic of running speed at which the vibration is occurring. Fig. 12(*a*) shows the nozzle resonance vibration at the thirtieth harmonic caused by the wakes of thirty standard-design stationary blades in the preceding row. Replacing the standard by the redesigned stationary blading reduced the stress to about $^1/_{10}$ of its original value as shown in Fig. 12(*b*).

The effects of flow conditions and blade and exhaust-hood configurations on the stresses at many resonant points are being studied. Fig. 13 illustrates the variation with exhaust pressure and mass flow of the resonant stresses at a gage on a standard last-row blade, vibrating in the seventh harmonic of the in-phase (++++) fourth mode (Fig. 11), with redesigned stationary blading and a standard exhaust hood installed. In the field, periods of operation of turbines at high capacity and very low exhaust pressure have preceded some of the last-row blade failures which have occurred. Consequently, it was thought that very high volumetric flows might contribute to the difficulty. Early testing showed an increase in stress with decreasing exhaust pressure in some cases, but further investigation has shown no pronounced trend. Work on this question, as well as other aspects of the blade-vibration problem, is continuing.

The test turbine has frequently been operated during vibration tests at speeds causing blade resonance and at flows near the maximum permitted by the brake. This has been done for every mode which produced a significant strain-gage signal, including the tuned modes, and as yet, all blades have withstood the vibration.

Acknowledgment

The authors wish to express their appreciation to F. K. Fischer for his guidance and direction during the development of this very useful facility. They also wish to express their thanks to J. E. Mullaney, F. J. Heymann, and H. M. Owens, who were responsible for much of the design.

[7] W. E. Trumpler, Jr., and H. M. Owens, "Turbine Blade Vibration and Strength," *Trans. ASME*, vol. 77, 1955, p. 337.

Abstracts and Comments Based on Current Periodicals and Events

D. FREIDAY
Assistant Editor

BRIEFING THE RECORD

The Vanishing Engineer?

In a cogent analysis of the distinction between scientists and engineers, Frederick C. Lindvall, Mem. ASME, chairman, Division of Engineering, California Institute of Technology, states in that institution's March, 1960, *Engineering and Science Magazine*, if failure to receive due credit for engineering achievements were the sole reason for concern, this could be put in the "don't-give-it-a second-thought department."

But the number of people entering the engineering profession is shrinking and the full effect will not be felt until 1962 or 1963, when the number of engineering graduates will be substantially below the figures for 1959 and 1960. During this same period the USSR expects to nearly double the 1958–1959 graduation rate of engineers. By all of the estimates made by the Engineering Manpower Commission, the future demand for engineers will increase, while at the same time the rate at which engineering graduates will be entering into the profession will be shrinking. This is a serious professional gap.

Professor Lindvall quotes James R. Killian: "Some of the great engineering accomplishments of our time have come to be loosely tagged, in the public mind, under the generic title of science. This confusion is not in the interest of either science or engineering, and the scientists are as unhappy about the confusion as the engineers. I do not advocate any less emphasis on science and its importance. I do urge a comparable emphasis on the role and importance of the engineer."

It is interesting to look at some over-all figures, the author states. We have in the United States, at the present time, approximately 200,000 scientists; about $^1/_2$ are chemists, $^1/_4$ are biologists, $^1/_8$ are in the earth sciences, $^1/_{10}$ are physicists, and about $^1/_{30}$ are mathematicians. (These and subsequent figures are from National Science Foundation sources.) Of these 200,000 scientists approximately 45 per cent or nearly half are in educational institutions. In this country we have approximately 600,000 engineers. This figure includes those who are graduated from engineering curriculums or who practice engineering in the sense in which I have been using it; it does not include large numbers of people who have adopted the name "Engineer"—as, for example, the Brotherhood of Locomotive Engineers.

The Significance of Objectives. The engineer is known by his works and his objectives. Long before the word "engineer" came into the language, certain men designed and built the structures of the ancient world, the palaces, the temples, fortifications, roads, and bridges. Fertile but arid lands were transformed by the miracle of irrigation into gardens for produce and for pleasure. Cities were made possible by water supplies brought from great distances in primitive aqueducts and were made livable by development of systems of waste disposal. The early engineer exploited water transport through canals, locks, and stream improvement and sought to control floods.

Gradually the ingenuity of man devised machines to replace human labor. The early engineer found new materials and new ways of improving old materials. His objective was to adapt nature to the needs and wants of mankind. But as he devised new schemes and new machines, he was also asking the question, "Why?" He was curious and sought to understand the workings of nature not solely for projection to new applications, but as new knowledge itself.

The Beginnings of Science. In his efforts to understand, we recognize the beginnings of science. Indeed, many of these early investigators whom we now call "scientists" were first of all pragmatic, practical fellows with specific objectives no different from those of engineers. And experimental science, beginning as early as the thirteenth century and flowering in the seventeenth, adopted empirical experimental methods then used by engineers and artisans. Engineering helped to stimulate the rise of modern science in the seventeenth century and was in turn changed in character by the birth of applied science in the nineteenth.

Now mid-twentieth-century technology is again working at the frontiers of knowledge. Engineers and scientists jointly are seeking new information and as a team are developing new applications. A new engineering development or new instrumentation brings to light unexpected facts which extend our knowledge in corroboration of existing history, or force re-examination of popular hypotheses.

As Francis Bello aptly stated in *Fortune*,[1] "The point where technology leaves off and science begins—the distinction between applied and basic research—has become increasingly fuzzy. In the 60's it will become fuzzier yet, for the great research tools that will dominate physical science in the years ahead will be engineering marvels first and research tools second."

The teamwork is so close that a clear identification of the engineering and science functions is difficult, Professor Lindvall states.

The scientist and the engineer form the team that paces today's technology. In science lie the foundations upon which the engineer builds toward a goal of the utility, comfort, and advancement of man. He is

[1] "The 1950's: A Forecast of the Technology," January, 1959.

concerned with machines, the environment in which they operate, and with the men who work with them and effect their control. He is further distinguished from his colleagues in science in his constant concern to achieve an optimum design to meet the many and frequently conflicting criteria of performance, reliability, efficiency, cost, and productibility. The associated synthesis, analysis, and design of an element or a system are unique characteristics of engineering.

The Importance of the Profession. The profession of engineering has thus become one of the most important in modern society. Our civilization would deteriorate, would become too weak to survive in modern world competition without the work of the hundreds of thousands of trained men (and the too few women) who keep the wheels of industry turning, who create new and useful products, who envisage, design, and build great factories, intricate communication, power, and transportation systems, and vast irrigation, navigation, and flood-control projects. The scientist and engineer have created for the first time in history a society potentially free from want—one more concerned, in fact, with surplus than with scarcity of many material products—as well as a society in which freedom from back-breaking toil has been largely achieved. Finally, in today's great international competition, America's ability or inability to aid engineering progress elsewhere may be crucial.

Must Explore for Himself. Engineering today is clearly in a state of transition, according to Professor Lindvall. New developments in science which have claimed the attention of scientists have left the engineer with large areas of what are called classical physics and chemistry which he must explore for himself if he wishes to develop the new knowledge he needs for application. Much of physics has become the domain of the engineer—including the physical properties of materials at extended temperature, solid-state physics, electricity and magnetism, thermodynamics, spectroscopy, and thermodynamic properties.

The engineer has also become increasingly concerned with problems of chemistry, particularly reaction kinectics and combustion processes. And the engineer today is perhaps the most important contributor to applied mathematics and to computer logic and design.

Clearly, the engineer of the future has opportunities and responsibilities beyond those which we know today. His capabilities in science, in analysis, and in design and the sophistication of the components and the complexity of the systems with which the engineer must work call for continuing professional development.

In addition to the greater understanding of modern science, and the synthesis of knowledge into engineering systems, a third function of the engineer is growing in importance. This is his management and technical leadership function.

Public Understanding Is Needed. All of this points to more and better education for engineers; to higher professional standards for engineering practice; to better support for engineers in the less exciting details of their work, concludes Professor Lindvall. We need public understanding of the role of the engineer and the place of the engineering function as a part of the technological process. Science provides support but not end objectives. The engineer must be recognized as a man of action with a high order of versatility in application of new knowledge to practical problems. He is a new kind of engineer. He is not vanishing; he is changing.

A single punched card causes the MOS computer to analyze production-schedule orders for inventory status of the materials. Purchase requisitions and shop-fabrication orders are prepared automatically.

Manufacturing-Cycle Control

CONTROL of manufacturing-cycle functions, from raw material to finished product, can now be combined into a single operating system through the medium of data processing. A Ramac 305 computer is used.

Requiring only existing data-processing equipment, IBM's new Management Operating System, MOS, can be fully activated by a customer order in punched-card form to carry out the six interrelated functions which are basic throughout the manufacturing industry. These are sales forecasting, materials planning, inventory management, plant scheduling, work dispatching, and operations evaluation.

The basis of MOS is the interaction of the basic manufacturing control functions which generate all plant activity. For example, sales forecasting produces a finished-product plan as machine output which, in turn, is entered as input for materials planning. When passed against the bills of material stored within the system, the finished-product plan produces total materials requirements. Materials requirements are checked against inventory, also stored within the system, to initiate purchases and manufacturing orders.

This chain of events, which is set in motion each time customer orders are entered into the system, continues through scheduling, dispatching, and finally operations evaluation. Operations evaluation monitors the preceding five functions and automatically creates exception reports for management, noting significant variations from established operational standards.

American Bosch Division of American Bosch Arma Corporation has been using some elements of the system with savings at the rate of $120,000 annually in production costs for the first six months of use. These have been applied to the related functions of materials planning and inventory management.

Management Operating Systems can be applied to all basic types of manufacturing industries. A program can be planned to fit any manufacturing organization, whether classified as a basic producer, converter, fabricator, or assembler of end-products.

Pneumatic Engine Control

A PNEUMATICALLY actuated control system for automatically starting, loading, and shutting down internal-combustion engines has been announced. Developed at the Fulton Sylphon Division plant in Knoxville, Tenn., of Robertshaw-Fulton Controls Company, specifically to meet the requirements of gas-compressing applications, the system is expected to have wide industrial application to automated processes. It incorporates safety functions to signal or shut down the engine due to malfunction of any one of an unlimited number of measurable variables.

Starting a high-horsepower engine involves a number of separate operations, all of which must be performed in a sequential order. It is also advisable to have them completely interlocked.

Upon a command to start, which may be initiated locally or from a remote location, the new system first monitors the various physical conditions of temperature, pressure, and so forth, associated with the particular engine to determine that all conditions are safe for starting. A remotely initiated start warns personnel who may be close to the engine that it is about to be started. The position of the suction, discharge, and bypass valves connecting the compressor to the pipeline are checked to determine that they are in the proper position.

Having determined that all conditions are suitable for the engine to be started, the first operation is to start auxiliary equipment—air-intake filter screens, prelubrication pumps, jacket water-cooling equipment, and similar items. Upon receiving intelligence that all these mechanisms are operating at proper values, the control system may then close the blowdown valve and open the discharge valve.

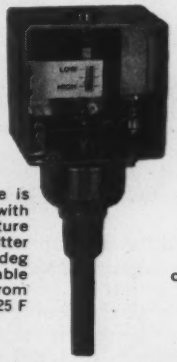
The next step, following completion of all previous steps, admits high-pressure air to the engine to start it rolling. After the engine has been purged of any residual gases, the magnetos are ungrounded to provide ignition. Following this, the fuel valve is opened, and with the engine running on gas, the starting air and auxiliary prelubrication pumps are halted. The suction valve is opened, the bypass valve closed, the engine is pumping, and engine speed is brought to the proper value by either automatic or manual means.

In general, the requirements of a sequence-start system may be defined that "no operation is initiated until intelligence is received that all previous operations have been completed and all are operating at proper values." In the event an operation in the sequence is not accomplished, or fails to function at the proper value, or if a malfunction develops, the control system halts the starting cycle, stops the engine, and indicates the reason.

The system is inherently explosionproof, an important consideration for gas-engine service. Diesel-engine operating conditions are met equally well. The "building block" concept provides maximum versatility and custom design for particular requirements. Straightforward pneumatic circuitry is employed with simplified standardized components for ease of maintenance and interchangeability. All measurable variables are monitored continuously and include temperatures, pressures, liquid levels, vibration, and engine speeds.

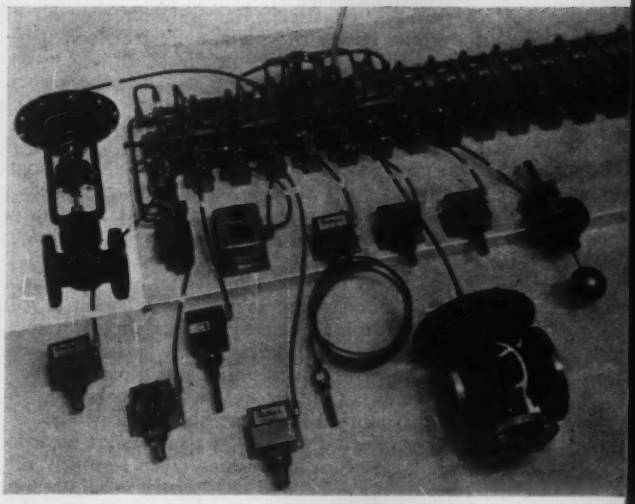
An important feature of the system is the nonresetting characteristic of the easily readable "bull's-eye" annunciators, which are flush mounted on the control panel. Through this arrangement, the indication of the specific abnormal condition causing shutdown remains visible until "cleared"—usually automatic with restart.

If any individual function fails to reach the correct operating level, the system locks out and must be restarted from the initial stage followng correction of the malfunction. Similarly, upon safety shutdown from any malfunction, the engine cannot be restarted until the cause of the shutdown (immediately identified from the annunciator position) has been corrected.



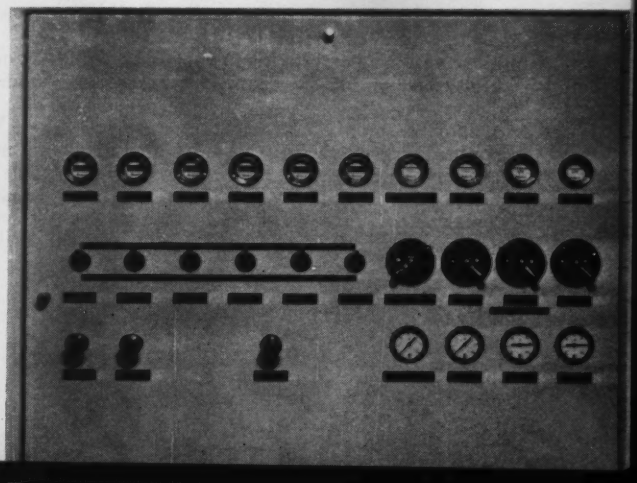
Temperature is monitored with a temperature transmitter having 35-deg adjustable ranges from 65 to 425 F

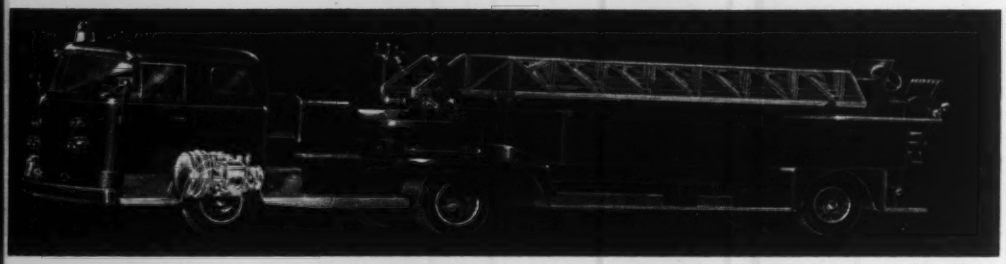
Green or red flags, in slot, indicate safe or unsafe state of temperature, pressure, or other variable



The receiver-relay-annunciator system has typical transmitters for temperatures, pressures, liquid level, and vibration. Fuel-gas valve is cut away to show inside.

The control panel has a row of bull's-eye indicators, toggle valves for simulating malfunctions, regulators and selector valves for automatic or manual starting, and dial indicators





Seattle's new gas-turbine-powered fire truck

Gas-Turbine Fire Trucks

GAS-TURBINE-POWERED fire trucks have been ordered by the Seattle and San Francisco Fire Departments. Both will be built by the American LaFrance Corporation of Elmira, N. Y., and will be powered by a 325-hp Boeing gas turbine made in Seattle.

The Seattle order is for a 100-ft 32,500-lb aerial ladder truck, and San Francisco's is for a 1000-gpm 30,000-lb pumper.

Reciprocating engines would weigh up to 3500 lb, whereas the Boeing turbine weighs only 325 lb or about one per cent of the total truck weight.

The high-torque performance of the Boeing turbine at low speeds will give the fire apparatus improved acceleration and hill-climbing capabilities and ability to move through city traffic at a faster over-all speed. With turbine power these giant fire trucks will be able to accelerate from zero to 55 mph in 34 sec.

Ceramic-Fiber Metal Combinations

A UNIQUE metallurgical process which combines ceramic fibers with metal to attain almost unbelievable strengths with less weight than all-metal castings has been disclosed by Horizons, Inc., a Cleveland, Ohio, process and materials-research organization.

While still in the experimental stage, the results are considered of major importance and a potential solution to some ultrahigh-temperature materials requirements.

Although the properties of the materials involved make the process much more complicated, the basic concept is similar to that in which fiberglass and plastic have been combined for numerous applications.

In fiber-reinforced plastics, glass fibers are incorporated in phenolic and other resins. The strength of such laminates is much beyond that which would be possible by use of the plastic alone—as much as 300,000 psi.

Some of the new high-temperature fibers now available for incorporation in metals have strengths as high as 3,000,000 psi, although the strength of the metal matrix alone would, in no case, exceed 500,000 psi. Such substantial reinforcement of a metal structure is possible even though the structure is being used at temperature close to the melting point.

Castings compounded from half fiber and half metal weigh considerably less than all-metal castings of identical mass.

Countless alloys and ceramic materials have been examined in the search for an ideal combination of metal and fibers. Research indicates that, to be acceptable, the metal could exhibit no precipitation phases resulting from alloy combination or heat-treating, and must maintain oxidation resistance substantially to the melting point.

The inorganic fiber must have a density less than that of the metal in question, a melting point very much higher than the metal matrix, a coefficient of expansion equal to or less than that of the matrix, an elastic tension modulus suitably greater than that of the metal, and strength—particularly at high temperatures—very much greater than the metal under consideration.

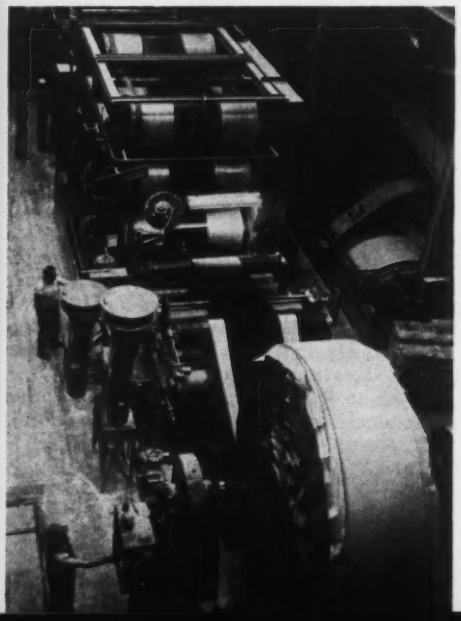
An alloy which comes close to meeting the metal specifications is an 80 per cent nickel, 20 per cent chromium composition; and the inorganic fiber best suited for incorporation is an aluminum oxide of sapphire or corundum in single-crystal form. These fibers are tough and flexible and can be wrapped around a radius of a fraction of an inch without fear of fracture. More important, about half of the fibers' high tensile strength is retained at the melting point of the nickel-chrome alloy.

Horizons has already licensed an east-coast firm to produce suitable ceramic fibers in a variety of mixtures and diameters although a number of problems must still be solved before a satisfactory structure can be produced for commercial and military use. Primary difficulties involve determination of fiber-to-metal ratios, fiber dimensions for optimum strength, techniques for "wetting" and bonding, and fabrication methods to maintain uniform dispersion of fibers in the matrix.

Calendering Conveyer Belting

PRECISION building of conveyer belts—as in tires—depends on controlled tolerances that can be provided only by electronic gages. From the standpoint of top quality and uniformity, calendering operations represent the most critical stage of belt building.

A two-story belt-calendering unit produces two to three miles of conveyer belting daily in lengths up to 2200 ft. Electronic gages insure uniform quality.



A huge, electronically controlled two-story belt-calendering unit which cost $1,600,000 has been installed by the Goodyear Tire and Rubber Company. It is capable of spinning out daily a two-to-three-mile ribbon of high-quality belting.

The four-roll calender device is designed for a maximum belt width of 72 in., maximum roll diameter of 156 in., and maximum weight of 20 tons.

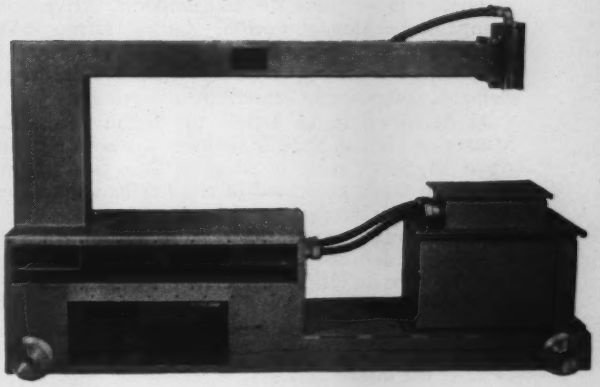
The longest continuous piece of belting turned out to date on the machine measured 2200 ft—almost half a mile long.

Two x-ray devices control the uniformity of the belt as it passes through the calender.

One x-ray device senses the gage of incoming components and reports thickness to the complex electronic panel.

After the belt passes through the calender, a second x-ray gage measures and reports the finished thickness. The belt then moves through a giant 12-roll cooling line and is wound into a coil, ready for curing.

Sheet steel is sorted for thickness by an x-ray gage mounted on a C yoke above a conveyer. Proper gage numbers are automatically imprinted.



Infrared Width Gage

An infrared width gage on a huge, $26-million hot strip mill at Butler, Pa., is cutting steel strip costs for Armco Steel Corporation.

The heat-radiation gage is noncontacting and operates from an infrared sensing head mounted above the moving strip, continuously scanning every inch of width. Highly accurate and responsive at strip speeds up to 2000 fpm, it operates even when strip edges are below the color range, registering as long as edge heat is 900 F or more. As long as sufficient radiation is reaching the gage head, even steam and oxide dust have no effect on its operation. Sidewise strip movements of as much as 3 in. on each side will not affect accuracy of the gage, and there is also no adverse effect when speed changes are introduced. The complete width-gaging system, designated Infra-Ray, is manufactured by Weston Instruments Division of Daystrom, Inc., Newark, N. J.

The gage head is mounted in a water-cooled, heavy steel housing about 14 ft above the strip bed and just beyond the last of the mill's six finishing stands. A permanently lubricated, ball-bearing motor shaft is the only moving part.

Steel strip is continuously scanned for width with a non-contacting infrared gage mounted in a water-cooled heavy steel housing as it passes from finishing stands

X-Ray Metal Sorting

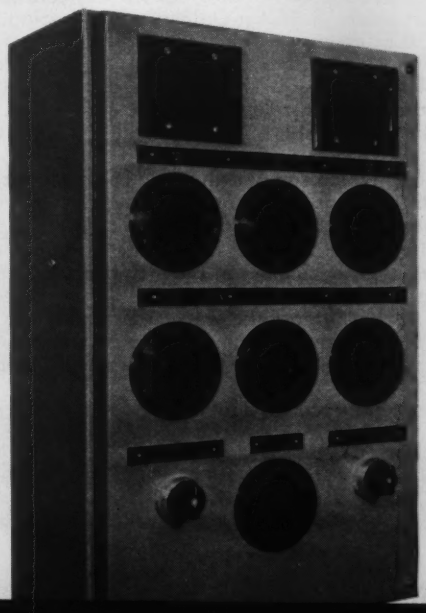
An x-ray sheet classifier does away with the conventional process of hand "miking" and stacking the sorted sheets of metal manually. The system, developed by Weston Instruments Division, Daystrom, Inc., is installed in a midwestern steel warehouse.

First, an x-ray gage monitors the thickness of sheets on a conveyer. Acting as an electronic micrometer, it emits sheet-measurement signals and, through an analysis-control console, also activates servomechanisms to mark the sheets and, in addition, sort them into stacking bins.

A marking device, placed downline from the gage, is pneumatically activated to imprint the proper gage number on the sheets.

Sorting bins are positioned beneath the conveyer and arranged to stack the sheets in any one of six different thickness ranges. Flap gates along the conveyer line—in this installation, one for each of six gages—are arranged to open individually upon signal from the control unit. Each sheet slides under the proper flap and drops into a self-stacking bin.

The gage size desired for each of six bins can be dial selected on a main console of the type used for multiple classification



The Harmonic Drive

A NEW family of drive systems departs from "rigid-body mechanics" and uses controlled elastic deflection of one or more parts for transmission, conversion, or change of mechanical motion. Called Harmonic Drive, these systems achieve high mechanical leverage by generating a traveling deflection wave in a flexing-spline element, composed of semielliptical springs.

As described in an article by the inventor, C. W. Musser of United Shoe Machinery Corporation, in the April 14, 1960, issue of *Machine Design*, a continuous deflection wave generated in the flexing-spline element achieves high mechanical leverage between concentric parts. A wave generator rotates within the flexible spline and deflects it slightly from its natural circular form into an elliptoidal shape.

As a result, the flexible spline meshes with the circular spline at two diametrically opposite regions on the major axis of the elliptoid. Teeth of the two splines clear at the minor axis.

Teeth on the flexible and circular splines are cut to the same circular pitch. But the number of teeth on the smaller flexible spline is slightly less than on the circular spline. To allow engagement at two diametrically opposite regions, the tooth arrangement must be symmetrical. For a two-lobe system having two regions of tooth engagement, the difference in number of teeth on the two splines must be an integral multiple of the number of lobes—that is, 2, 4, 6, and so forth. The pitch circle of the flexible spline is made smaller than that of the circular spline in proportion to the difference in the number of teeth.

As the wave generator is rotated clockwise, the flexible spline is deflected progressively outward, causing continuous and greatly reduced tangential motion of the flexible spline. Motion of the flexible spline is in a counterclockwise direction for clockwise motion of the wave generator. For a full revolution of the wave generator, the flexible spline will counter-rotate through an angle proportional to the difference in the number of teeth on the two splines.

Basic Characteristics. The distinctive characteristics of this drive system can be seen in the illustration. Flexible and circular splines are fully engaged at the major axis but move angularly relative to one another at all other points, with maximum relative motion occurring at the minor axis. If the wave generator is rotated clockwise at a constant angular velocity, the flexible spline will counter-rotate at a constant, but greatly reduced, average angular velocity. This characteristic is the basis for a great many types of high-reduction rotary systems.

The drive system is reversible. A small counterclockwise rotation of the flexible spline will induce a magnified clockwise rotation of the wave generator. This characteristic is the basis for high-ratio speed-increaser systems.

In ordinary operation, as the wave generator is turned, the flexible spline is progressively deflected to follow the rotating elliptoidal shape. Starting at the fully engaged position, the tooth on the flexible spline gradually disengages, advances, and re-engages as the wave generator is turned a half revolution. In a 130-tooth flexible spline and 132-tooth circular-spline system, for a full rotation of the wave generator, the flexible spline counter-rotates through an angle equivalent to 2 of its 130 teeth, giving a 65:1 reduction ratio.

In these drive systems any one of the three basic elements (wave generator, flexible spline, or circular spline) can be held fixed, and the other two used interchangeably as input and output.

Materials. SAE 4340 steel has been the preferred construction material. Although the flexing elements are subjected to cyclic-stress conditions, fatigue has not been a particular problem.

Wave-generator configurations can also be varied. Elliptoidal-cam, spaced-roller, ball-planetary, and variable-ball-planetary forms are all possible.

Application. The range of application of this new type of mechanical system can be extended by combining drive stages to form multiple-stage systems. Drive stages can be compounded radially or axially. Ratios of 1,000,000:1 can be achieved with only two compounded stages.

Explosive Compaction of Powders

PRESSURES in excess of 1,000,000 psi have been readily obtained in experiments on explosive compaction of powders. The results, obtained with double-piston presses at the U. S. Naval Ordnance Test Station, China Lake, Calif., are reported in an unpublished paper, "The Explosive Compaction of Powders," by John Pearson, head, Detonation Physics Group, in the Michelson Laboratory at the Station.

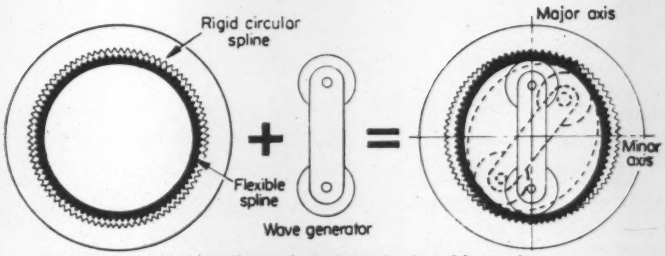
Unlike the Battelle Laboratory and Bridgman experiments (MECHANICAL ENGINEERING, September, 1959, pp. 64–65), which combine high temperatures with high pressures, there is no appreciable temperature factor in the process.

The hydrostatic compression of the Bridgman experiments resulted in changes in the material which were of an elastic nature and largely reversible upon release of load. In the China Lake work, the presses can be designed so that the specimen is free to undergo plastic deformation and the resulting changes are of a permanent nature.

Although the process has been used solely for research, recent work has indicated that the explosively activated press concept may lend itself to numerous industrial applications.

Final density of the specimen is closely related to the ductility of the material pressed and ranged to in excess of 95 per cent of that of a rolled bar when ductile titanium filings were used. Further compaction may be possible through the use of successive shock loads or by increasing the impulse imparted to the specimen. Some ductility is necessary if the particles are to cohere under press action. Diamond dust and some ceramic compositions which are quite brittle do not cohere and remain a powder. Brittle materials normally undergo a decrease in particle size and demonstrate good compacting properties, but they generally produce little bonding strength.

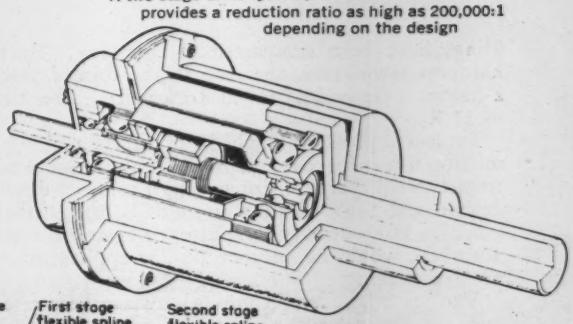
It may be possible to utilize the desired properties of a brittle material by press bonding it into a more ductile matrix by mixing the powders before pressing or surface bonding the powders onto discrete objects. Another application would be bonding layers of dissimilar materials. Alternate layers of iron filings and titanium

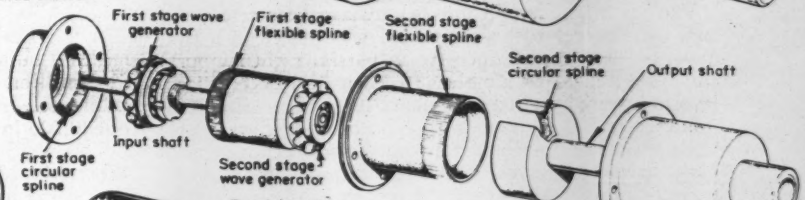


In the harmonic drive, the basic 3-element rotary-drive system converts controlled radial deflection—produced by the rotation of a wave generator—into tangential motion. The result is a new class of constant-ratio mechanical-drive systems for power transmission, angular positioning, or motion conversion. Motion can even be transmitted through a hermetically sealed barrier.

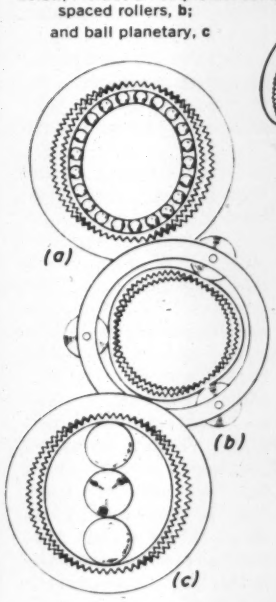
HARMONIC DRIVE

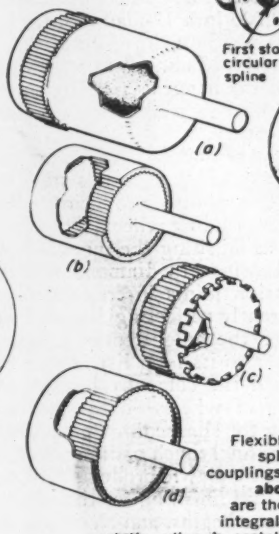
A two-stage drive system, **first two rows below,** provides a reduction ratio as high as 200,000:1 depending on the design



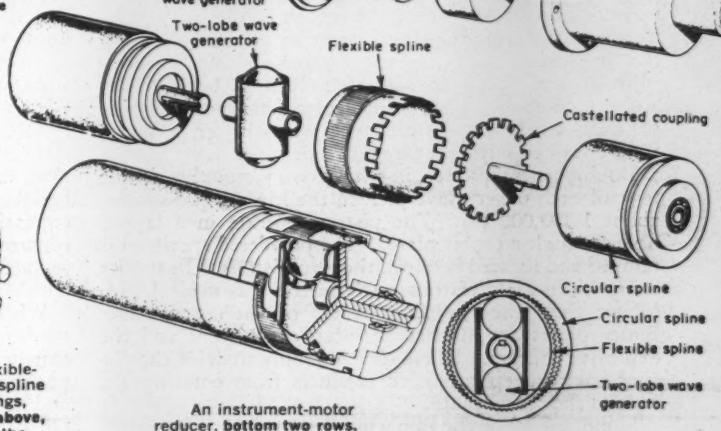


Possible wave-generator configurations, **below,** include an elliptoidal cam, **a;** spaced rollers, **b;** and ball planetary, **c**





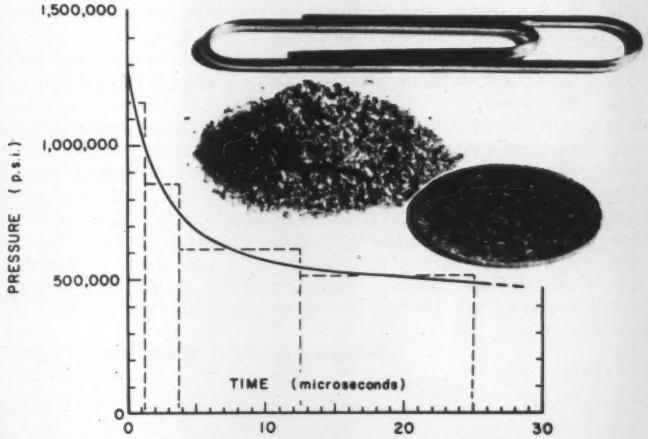
Flexible-spline couplings, **above,** are the integral, **a;** static spline, **b;** castellated, **c;** and dynamic spline, **d**

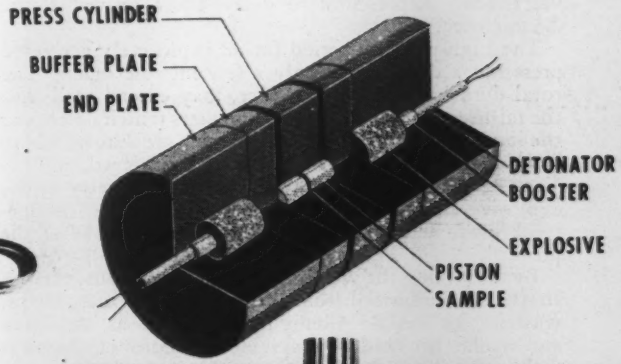


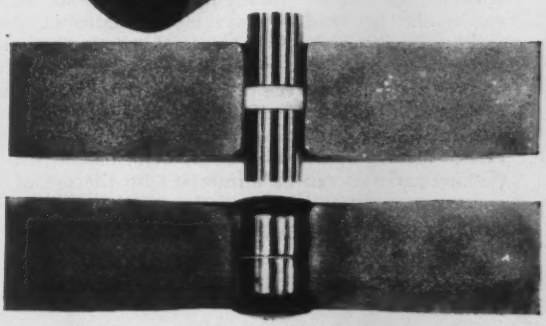
An instrument-motor reducer, **bottom two rows,** with a single-stage drive system uses a two-lobe wave generator to provide 350:1 reduction in the short extension of the instrument-motor case

EXPLOSIVE COMPACTION

Compaction of powders at pressures in excess of 1,000,000 psi has been obtained with explosive-driven double-piston presses. The titanium filings, **below,** were compacted into a disk smaller than a paper clip. The pressure-time curve for a double-piston press is below them. Cutaway view of double-piston press shows the use of primacord leads. Cross-sectional views of center plates of double-piston presses, **below right,** show the relative appearance of pistons and specimens before and after firing.







filings have been compacted in this way. By microhardness techniques, the iron in the formed piece had a hardness equivalent to 30 Rockwell C, the titanium to 33 R_c.

Explosive pressing would be useful for making transmission filters for x-ray or optical equipment where extremely small particle size and high compact density are desired and high bonding strength is not normally required. High-density graphite compacts for neutron absorbers would be another similar application for explosive forming.

Various methods of compaction have been tried. In one, the powder to be compacted was placed in a thin cloth or plastic container (with partial rigid support) and subjected to an air blast from an explosive charge. Pressures were insufficient for metallurgical bonding.

Several types of presses have been used. One was a hollow tube of ductile metal coated with a thin layer of plastic-type explosive which permitted detonation to travel symmetrically along the length of the tube. Unfortunately, during the elastic-recovery process following the implosion, large tensile stresses set up in both cylinder and specimen sometimes caused both to fly apart. Although a slow-load-release method was developed, work was discontinued when better pressures were obtained with another method.

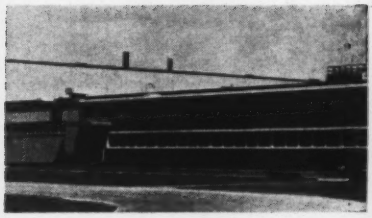
Double-acting presses, in which two pistons are driven toward each other, have yielded the highest pressures—about 1,300,000 psi. The pistons operate in a lapped hole through a center plate. The powdered specimen is tamped and located between the two pistons. In studies using $^1/_2$-in-diam pistons, each piston was made $^1/_8$ in. longer than the $^1/_2$-in. thickness of the center plate. Buffer plates are inserted between the pistons and the explosive charges. These serve not only to drive the pistons but to keep explosive products from entering the hole in the center plate.

Simultaneity of the opposing detonations is necessary and is obtained by using primacord leads of equal length. A variation of $^1/_4$ in. in length results in a time delay of only 1 microsec and these leads can be cut to an accuracy of a small fraction of an inch. Both leads are cut from the same spool of primacord to insure against batch variations. Representative delay times proved to be 0.5 microsec.

The high-pressure period for an explosively activated press has a duration of only a few microseconds. The total duration of load, however, may extend well into the millisecond range. The parameters which determine the impulse (that is, pressure and time) are susceptible to some degree of control. This can be achieved by: (*a*) Varying the amount, the type, and the geometry of the explosive charges, (*b*) the degree of explosive confinement used, and (*c*) by varying the over-all size of the press.

By machining the working faces of the pistons, various shapes can be formed from the powders—crosses, strips, washers, or disks. Configurations such as the cross and washer are readily adaptable to studies of electrical and magnetic properties. Other shapes, such as the tensile strip, are of value in studying stress-strain relations and the elastic properties of objects formed from powders.

Pistons were machined from 1 per cent carbon steel (drill rod), while the bulk parts of the press were a low-carbon steel. The severe plastic deformation which the pistons undergo can be minimized by the use of Teflon spacers to regulate the separation distance.



Youthful Vigor at 75

It is a healthy company indeed that can open a $6.5-million building on its 75th anniversary, boast of $175-million sales, and display 24 plants with 13,500 employees—all parlayed from an initial investment of $20,000 in a 12-man plant.

Tops in the field of abrasives, the Norton Company, Worcester, Mass., is expanding into new areas based on its electrochemical and high-temperature research and know-how in preparation for the finishing stretch of its first century.

As large and as complex as its manufacturing operations are, the company is still essentially a "very large small-job shop" producing about 200,000 types and sizes of grinding wheels for such widely varying applications as finishing the inner and outer races of miniature ball bearings to diamond wheels for grinding out the expansion joints in concrete highways. The company is currently perfecting diamond grinding of plate glass to replace the cumbersome present use of sand and add another to its long list of uses for abrasives.

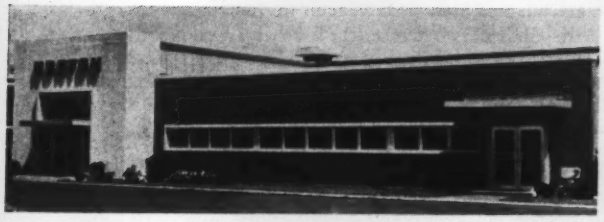
When the company began business there were three grades of wheels—hard, medium, and soft—used primarily for sharpening and polishing. Today, abrasives put the final touch of dimensional accuracy on most metal and many plastic products. Where bonded wheels leave off, barrel finishing for the tumbling of parts amid loose abrasives begins, and Norton is also a leader in that area.

Grinding wheels are still the basic product, and the new $6.5-million Plant 8 utilizes the latest in materials-handling and process techniques to improve product and speed delivery—particularly on the many small-quantity special orders. Organic-bonded (resinoid, rubber, and shellac) wheels are produced in an integrated operation. (Another large building produces vitrified wheels.)

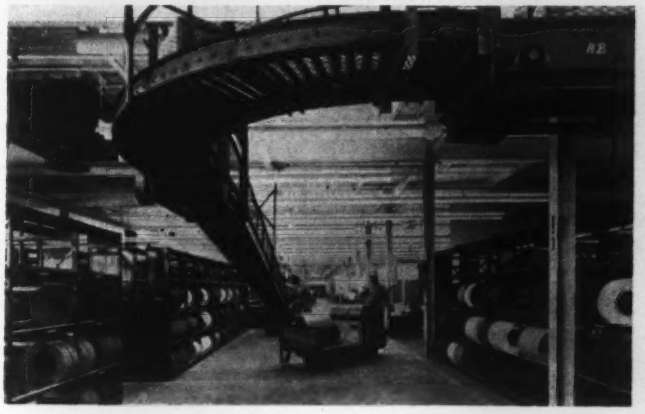
There are essentially three manufacturing steps: Selection of carefully weighed quantities of a variety of abrasives; compression of the mixture of abrasives and bonding materials; and curing.

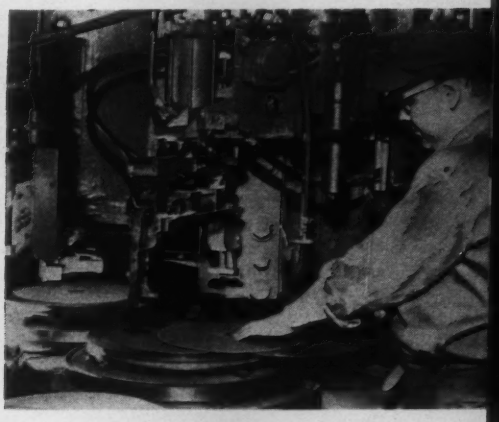
Ingredients are selected by a punch-card-operated automatic-weighing device. This has three weighing carriages suspended from a monorail which pick up exact quantities of the required ingredients for the punch-card recipe from a row of raw-material tanks. Designed by Norton engineers and the Heltzal Manufacturing Company, Warren, Pa., it is so new that it is still being debugged.

When all the ingredients in the batch are drawn, the carriage moves around the loop to the mixing area where the hoppers are automatically discharged onto a spur monorail at one of nine mixing positions, indicated on the punched card. Before returning to the beginning of the cycle, an empty hopper is placed in the carriage, again automatically, and the cycle repeats with a new card. Each card becomes part of the record for its own batch of wheels.



Norton Company's new Plant 8, **left,** has 26 miles of shelving, **below left,** serviced by overhead conveyers to stock 6,000,000 finished grinding wheels that are ready for the market. An automated three-station press, **below right,** produces pressed wheels from automatically selected and delivered materials. The mold is filled at one station, and a wheel pressed at the next station while the operator removes a pressed wheel at the third station.





A three-station hydraulic press automatically and uniformly fills the mold with the correct amount of abrasive and bond mix at the first station. At the second station, the mix is pressed hydraulically. The operator is at the third station where he removes the pressed wheel and readies the mold for the next cycle. All three operations are performed simultaneously.

The pressed wheels are heat-treated in continuous ovens with automatic temperature controls to cure the organic bonds, changing the soft molded-abrasive mix into grinding wheels.

In the finishing operation, sides of the wheels (other than cut-off wheels) are ground parallel and straight on a Norton-designed and built siding machine which handles wheels up to 42-in. diam. After the sides have been finished, the holes are precision reamed to correct size, straightness, and concentricity on an adaptation of a honing machine.

Company research has been concerned first with two basic materials—aluminum (aluminum oxide) and Crystolon (silicon carbide). A new 75 Alundum—a prismatic crystal only $^1/_{2000}$th of the size of ordinary aluminum-oxide crystals—is capable of removing twice as much metal per wheel as the best wheels previously used. The company has had considerable success in synthesizing abrasive-quality diamonds and has worked closely with the General Electric Company, the pioneer in this field. Magnorite (magnesium oxide), Norbide (boron carbide), zirconia, and many other refractories with special properties have come from high-temperature research. A special metallizing gun has been developed which melts pure sintered-oxide rod and impinges the molten material on the surface of the material coated to counter erosive conditions. Silicon-carbide crystals, catalyst supports, silicon-carbide refractories for the aluminum industry, radome manufacturing methods, and nuclear ceramic fuel elements are just a few of the "fringe" developments from the company's research program.

The Norton Company not only counters the popular myth of New England conservatism, but also disproves the old shirtsleeves-to-shirtsleeves saw. The son of one of the founders, George N. Jeppson, Mem. ASME, at 87 is chairman of the board and visits the plant daily. His son, John Jeppson, is a vice-president and general manager of the abrasive division. Milton P. Higgins, president, is a grandson of his namesake who was first president of the company.

In spite of the close descent of the management and the close ownership—all growth has been financed from the original $20,000 investment—any door in the building, including that of the president or the board chairman, is open to any employee with a complaint or a suggestion.

Pumped Storage Gets Bigger

CONSTRUCTION has begun on Appalachian Power Company's 440,000-kw $50-million Smith Mountain combination hydroelectric project on the Roanoke River in Virginia.

When completed in late 1962, it will be the largest hydroelectric installation in the United States featuring pumped storage.

The project includes two dams. The upper-dam hydro plant will house four vertical-shaft hydraulic turbines, including two which will be reversible to function as pumps (to move water from the lower to the upper reservoir during off-peak hours for reuse during peak hours), and the lower-dam plant will have two vertical-shaft hydraulic turbines. Provision has been made at the upper dam for a future fifth unit, of 140,000-kw capacity, which would raise the total capacity to 580,000 kw.

The upper lake will cover about 20,000 acres, the lower one about 3400 acres.

Nuclear Briefs

▶ Nuclear-Powered Manned Aircraft

Pratt & Whitney Aircraft Division of United Aircraft Corporation is making "significant strides" in the development of an indirect-cycle liquid-metal system for a nuclear-powered manned aircraft. Research has progressed to the point where the Aircraft Nuclear Propulsion Office plans the fabrication of an experimental ground-test reactor to prove out the basic materials and components. (The Aircraft Nuclear Propulsion Office co-ordinates the programs of the Atomic Energy Commission and the Air Force.)

The nuclear reactor would be remote from the turbojet engine with liquid-metal coolant carrying nuclear heat from the reactor to a radiator in the turbojet, where it would be exchanged to the air to produce thrust. The potential is attractive for performance in supersonic as well as subsonic applications.

The technology in both the power plant and the airframe areas has advanced to the point where there is confidence that nuclear-powered, sustained flight can be demonstrated.

Kenneth K. Klingensmith, Assoc. Mem. ASME, is project engineer, and Carl D. Lingenfelter, Mem. ASME, is performance group leader of the Company's nuclear propulsion program which began in 1951.

▶ 360,000-Kw Nuclear Power Plant

Construction of the nation's largest atomic power plant may be started next year by Southern California Edison Company. A letter of intent to negotiate contracts for the design and construction of a 360,000-kw $70-million plant has been sent to the Westinghouse Electric Corporation who would supply the steam and electrical equipment and to the Bechtel Corporation who would be engineering constructors.

The plant is expected to be economically competitive with conventional plants over its lifetime and is also expected to require about four years for the completion of construction.

▶ Operable Reactors in U. S. Exceed 100

The operable nuclear reactors in the U. S. alone, including power, propulsion, production, research, and test reactors, number well in excess of 100, according to U. M. Staebler and D. H. Stewart of the U. S. Atomic Energy Commission in remarks addressed to the Columbia Basin Inter-Agency Committee. "A comparable number are under construction and more are planned."

▶ U. S. and U. K. to Exchange Gas-Cooled Reactor Data

The U. S. Atomic Energy Commission and the U. K. Atomic Energy Authority, acting as agent for the Board of Management of the Dragon Project—joint U. K.-Western European high-temperature gas-cooled reactor—have agreed to the exchange of detailed information on high-temperature gas-cooled power reactors. The Dragon Project involves construction and operation of an experimental 20-tmw reactor at Winfrith Heath.

The information exchange will cover the Dragon Project and the 40-emw High Temperature Gas-Cooled Reactor to be built by the Philadelphia Electric Company. Research and development for the U. S. reactor are being performed by the General Atomic Division of General Dynamics Corporation.

▶ Materials and Standards Reactor for NBS

Allis-Chalmers has recently been awarded a contract to assist the National Bureau of Standards in the design of a nuclear reactor to be used by NBS in basic research on materials and in the establishment of standards for various types of nuclear measurements.

Tentatively, the reactor will be an advanced version of the "tank-type" CP-5 reactor at Argonne National Laboratory. Employing enriched-uranium fuel elements, the heterogeneous heavy-water cooled and moderated reactor will operate initially at power levels up to 10 mw. Provision will be made in the design to permit ultimate operation at power levels as high as 20 mw.

Materials Briefs

▶ Aluminum Powder-Metallurgy Impact Extrusions

Close-tolerance parts that retain strength and corrosion-resistance properties at elevated temperatures are being made by the Aluminum Company of America's Edgewater, N. J., works with aluminum powder-metallurgy impact-extrusion methods. Fin tubes have been extruded incorporating up to 10 fins on $^1/_4$-in-diam tubing with lengths up to 14 ft even with spiraling exterior fins.

Normal maximum and minimum size limits for impacts apply to the new process. Tolerances of parts made by the new method are well within the close normal impact ranges. Parts have, in fact, been fabricated within tolerances of 0.0025 in.

▶ Improved Solid Lubricant Ups Load-Bearing Capacity

A solid lubricant with as much as 20 times the normal load-bearing capacity has been announced by the General Electric Research Laboratory. The improved lubricant was achieved by the addition of various inorganic sulfides to the well-known lubricant molybdenum disulfide, or to tungsten disulfide.

With the addition of silver sulfide to the lubricant, the load-bearing capacity of a $^1/_8$-in-diam chrome-alloy steel hemisphere in sliding over a mild-steel surface increased from $^1/_4$ kg for pure molybdenum sulfide to 5.3 kg with the additive. Even better results are obtained when the lubricants are used on relatively hard surfaces, such as chromium. The additives are all inorganic sulfides, and their effects can be noted at relatively low concentrations.

▶ High-Temperature Vinyl Usable for Plumbing

A new vinyl plastic that withstands temperatures 60 deg higher than conventional vinyls can be used in household hot-water plumbing and even in industrial hot-acid piping. Operating temperatures of 180 to 200

Plastic plumbing made of Hi-Temp Geon can be assembled from threaded parts or with the use of a solvent to form weld-tight joints

F and pressures up to 150 psi are possible, whereas normal household pressure is only 50 to 60 psi. Developed by B. F. Goodrich Chemical Company, the new material is a polyvinyl dichloride which has been called Hi-Temp Geon.

The new material retains all the qualities of strength, light weight, impact resistance, nonflammability, and corrosion resistance that have made vinyl the second-largest selling plastic in the world. Solvent welding is used to make pipe connections, and preassembled plumbing walls are possible.

▶Stainless-Steel Layered Construction

Tissue-paper-thin strips of AM-355, a precipitation-hardening stainless-steel alloy, wound layer upon layer, then spotwelded into a strong cylindrical rocket chamber, have withstood 305,000-psi hoop stress. Previously, 240,000 psi was the highest obtainable when a single thickness of low-alloy steel was used.

The AM-355 developed by Allegheny Ludlum Steel Corporation is cooled to subzero temperature, cold rolled, and tempered.

High strength and ductility are characteristic of a layered construction made of tissue-paper-thin strips of AM-355. These are wound layer upon layer and then spot-welded

▶Light weight Alloy Steel

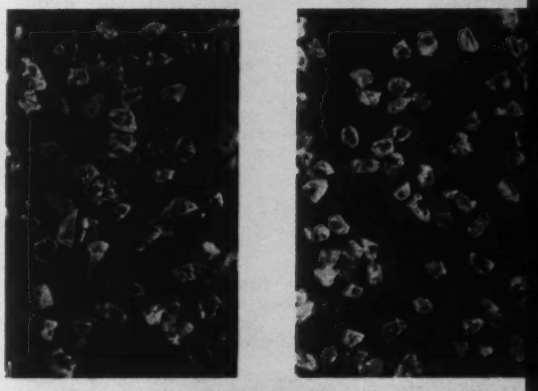
The new, light gages of USS "T-1" constructional alloy steel, developed by U. S. Steel Corporation especially for the Army's missile program, combine outstanding strength with minimum weight. Heat-treated at the mill, they have a yield strength of 100,000 psi —about three times that of structural carbon steel rolled to the same thickness and weight. Moreover, the thin sections can be formed readily and welded without any loss of strength.

Outstanding strength and minimum weight of Alloy T-1 not only pared weight from the Sergeant missile but saved 7000 lb in weight of the erector-launcher

▶Improved Natural-Diamond Grit for Metal-Bond Wheels

Only the strongest, most abrasion-resistant diamond particles are selected for a new type of natural-diamond grit, especially suited for use in metal-bonded cutting and grinding tools.

Diamond Research Laboratory, Johannesburg, South Africa, which developed the grit, has achieved a 30 to 50 per cent faster cutting rate for concrete, marble, tile, and similar abrasive materials than was previously possible.



Conventional natural-diamond grit, left, includes irregular particles that are weak and friable and that break down. These are elliminated in the selected grit, at right.

▶ Bonded Dry-Film Lubricant

A bonded dry-film lubricant, manufactured by Poly Chem, Indianapolis, Ind., coats the hinges of the wing flaps of the Convair 880, an 88-passenger swept-wing airliner which cruises at 615 mph. This baked-on dry Poxylube 75 lubricant enables the flaps to operate more efficiently under extreme wind pressures and temperatures.

No surface preparation except degreasing is required and it is applied easily by spraying, dipping, or brushing. The lubricant can be applied to glass, wood, plastics, structural metals, or metal products, and is most effective in the thicknesses that are in the range from 0.0001 to 0.0005 in.

New Methyl antiknock agent for gasoline raises the quality of premium grades for automobiles by one or two octane numbers

▶New Antiknock Agent

A more effective antiknock agent is being used in place of tetraethyl lead by the Standard Oil Company of California. It is tetramethyl lead, known under the trademark Methyl in its gasolines. On an equivalent lead-concentration basis, it raises the quality of premium gasolines one to two octane numbers.

PHOTO BRIEFS

M. BARRANGON

1 Stainless-Steel Condenser Tubes. The problem: Water that is corrosive to condenser tubes. The solution: Stainless-steel tubes, applied here at Duquesne Light Company's Elrama Power Plant. Type 304 stainless-steel tubing, here supplied by Allegheny Ludlum Steel Corporation, has a life expectancy of 30 years as against five to eight years for nonferrous tubing previously used, and it has about the same heat-transfer ability.

2 Re-entry Turbine. For applications like Dyna-Soar, the Garrett Corporation's AiResearch Manufacturing Division of Los Angeles developed this integrated system, using liquid hydrogen and oxygen to drive a turbine to provide both hydraulic and electric power. The system, designed on a redundancy principle for reliability, can provide cooling for the crew, equipment, and structure. AiResearch has been developing hydrogen systems since 1955.

3 Combustion Chamber. For their 502 series of small gas turbines, Boeing Industrial Products Division developed a combustion chamber giving increased performance and enabling the use of many fuels, from diesel and jet fuels to unleaded gasoline and kerosene—without adjustments. More than 100 burner-dome inserts and liners were tested in the program. In the photo, a Boeing engineer, surrounded by test patterns and types, displays the final design.

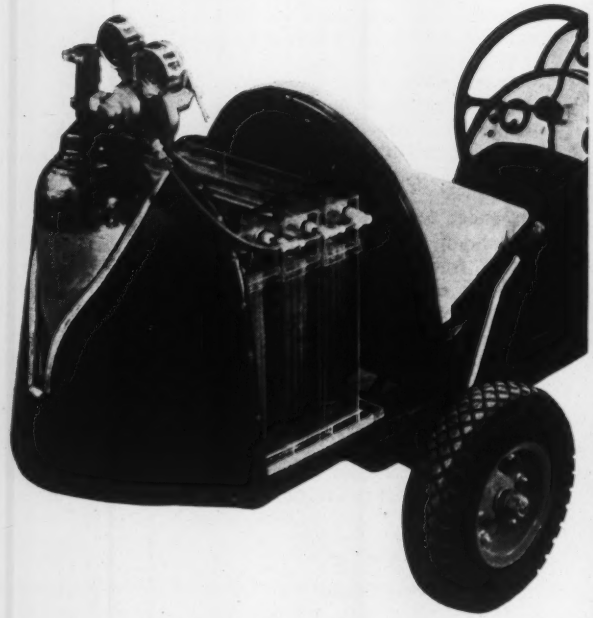
4 Thermoelectric Generator. Westinghouse has developed the most powerful thermoelectric generator ever built, for the Bureau of Ships, U. S. Navy. This thermoelectric portion of each subgenerator resembles a hollow cylinder about 30-in. diam and 30 in. high. The thermoelectric modules form the walls of the cylinder, their hot inner surfaces exposed to the flame of burning kerosene. Outer surfaces are water cooled. Flow of heat through the thermoelectric materials generates electricity.

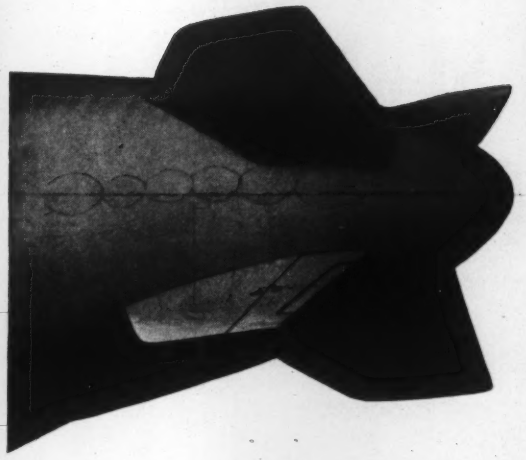
5 Missile Tracker. The first of the giant radar tracking antenna structures for BMEWS (Ballistic Missile Early Warning System) has been completed by Goodyear Aircraft Corporation and is undergoing tests by Radio Corporation of America. Pedestal and antenna weigh nearly 375,000 lb, yet the dish has precision rotating capability and can complete a scan of the skies in a matter of seconds. A hostile missile will be picked up and its path determined. Warning: About 15 min.

6 Welding Carriage. For the 225-ton, 375-ft main-span girders of the Nisqually Glacier Bridge at Mt. Ranier National Park, the West Coast Steel Works, Portland, Ore., developed a simple travel carriage for submerged-arc welding. The carriage carries the welding gun of Lincoln Electric Company's ML-2 squirt welder and an acetylene torch. The torch drives out moisture. The 16-ft 8-in. webs are split in half and later joined by field welding.

Air Lift

How do you get 40-ton rocket-booster stages from factory to launching site? Goodyear Aircraft Corporation, long-time builder of lighter-than-air craft offers this solution. No tunnels, no highway clearances, no damage to sensitive components. A 5,000,000-cu-ft airship could handle the Saturn-type booster stages.





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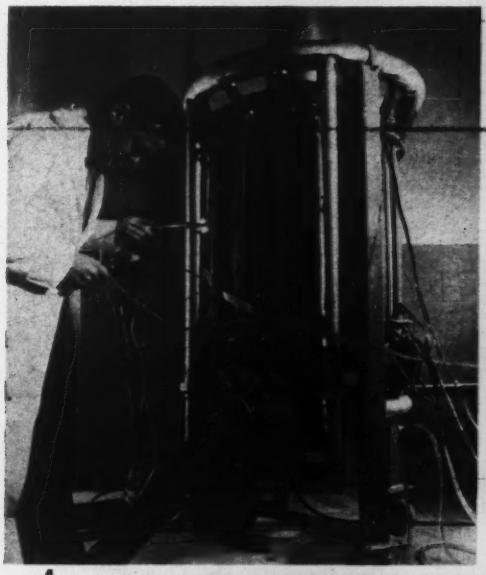

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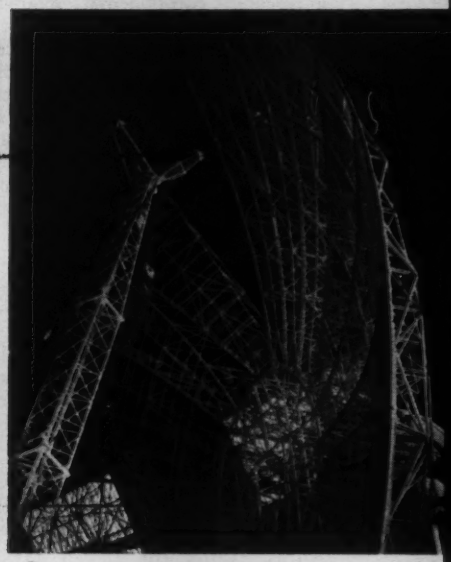

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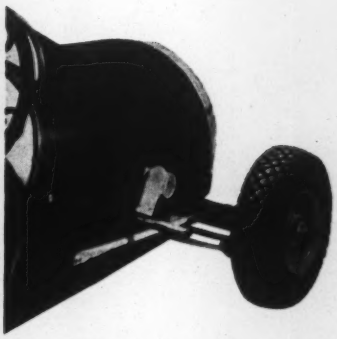


Fuel Cell

Potentially one of the most efficient sources of power. Exide's prototype fuel cell, producing electric currents directly from chemicals, powers this racer. Intended first for industrial trucks, the cell may be adapted to automobiles which will be smog-free and silent. Zinc fuel is oxidized in potassium-hydroxide electrolyte.

6

Engineering Progress in the British Isles and Western Europe

J. FOSTER PETREE
European Correspondent

EUROPEAN SURVEY

Twin Automatic Lathe

WHAT is now generally known as the "Swiss-type" automatic lathe, with a number of tools arranged radially round the chuck and others operating axially, is now well known and was represented at the Swiss Industries Fair by a number of examples. A development of it, shown by the Usines Tornos S.A., of Moutier, Switzerland, is the "Vice-Versa" lathe, in which two such units are mounted side by side on a common bed. It is intended for the production of very large batches of complicated components, requiring more operations than can be carried out in a single lathe. It can be used for a number of operations on the end of a component after it has been cut off from the bar. On completion of the operations undertaken in the first headstock, the component is picked up by jaws at the end of a swinging arm and transferred to the second headstock, where it is automatically chucked and the work finished. The machine will take stock up to $^1/_2$ in. diam and will produce parts up to $2^3/_4$ in. long.

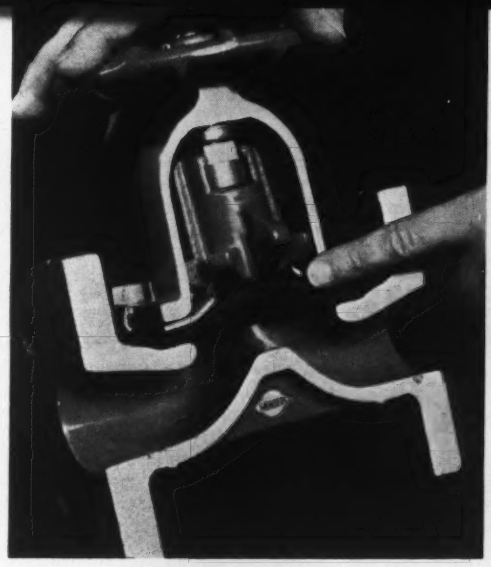
Industrial Fairs

THE multiplicity of national and international trade fairs now regularly held in Europe is beginning to pose problems for those who rely on these displays as a means of keeping informed on current developments in different countries. This year, for example, the Swiss Industries Fair opened on April 23 at Basel and the German Industries Fair on April 24 at Hanover, and both closed on May 3. As a result, anyone who wished to attend both could not give to either as much time as he might have if there had not been this overlapping.

This year the Swiss Fair attracted some 800,000 visitors during the eleven days that it was open—about 50,000 more than last year—and the German Fair was as well patronized as ever. The Swiss Fair showed the goods of 2350 exhibitors; the Hanover Fair, those of 4700, about 800 coming from 25 countries other than West Germany. In both, mechanical-engineering exhibits figured prominently, with machine tools predominant at Basel where, space being limited, they alternate with textile machinery in successive years. At Hanover they were less noticeable, since a separate machine-tool exhibition will be held there in the fall.

Correspondence with Mr. Petree should be addressed to 36 Mayfield Road, Sutton, Surrey, England.

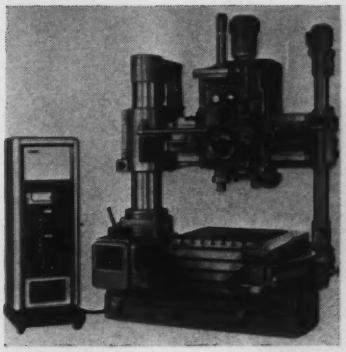
Machine tools on display at the Swiss Industries Fair, Basel, Switzerland, **top**, and a collection of cranes at the German Industries Fair, Hanover, Germany, **bottom**



A sectioned "A" type Saunders diaphragm valve showing the Terylene reinforcement

Terylene Diaphragm Valves

Rubber, both natural and synthetic, is a common material for diaphragm valves—for the valves themselves and for lining the bodies where this is necessary. The Saunders Valve Co., Ltd., of Cwmbran, South Wales, large manufacturers of such valves, have developed a type in which Terylene is used as a reinforcement for the rubber. Preliminary tests and extensive experience showed that the new construction was stronger and had a longer life than the old; hence the company is now incorporating this reinforcement in a majority of their diaphragms. It is in the form of a fairly open mesh, which is molded into the rubber or other valve material.



Swiss-made Oerlikon R2 jig borer with punched-tape control shown at the Swiss Industries Fair

Tape-Controlled Jig Borer

As in most machine-tool-using countries, automatic control, to within limits only attainable by electronic means, is making considerable headway in Switzerland. Typical of machines so equipped in the 1960 Fair was the Oerlikon R2 jig borer, made by Buehrle & Company, Oerlikon Machine Tool Works, Zürich, in which automatic co-ordinate positioning is effected by a punched tape. The machine has a clearance between the columns of 1490 mm (58.66 in.), a vertical gap between spindle and table of 700 mm (27.56 in.), from spindle to bed of 1220 mm (48.03 in.), and a traverse of 1080 mm (42.52 in.). The 6-hp quillhead motor runs at 1500 rpm. There are 18 spindle speeds, over a range from 38 to 1900 rpm on the standard machine, and 15 spindle feeds (12 for drilling and boring, and three for reaming). The table has quick motions in both directions for setting or return. The spindle nose takes Morse No. 5 taper. The maximum boring diameter is 300 mm (11.81 in.) and the largest milling cutter that can be used is 120 mm (4.72 in.). Larger machines of the same general design are made.

Hot-Metal Mixer

In the open-air portion of the German Industries Fair there are usually some outstanding examples of heavy engineering. Particularly striking this year, because it stood on a railway track opposite the main entrance, was a torpedo-shaped hot-metal mixer on rail mountings, constructed by the Jünkerather Maschinenfabrik G.m.b.H. (a constituent of the Demag group of companies) for the Phoenix-Rheinrohr A.G. Steelworks at Duisburg-Ruhrort. It consists of a cylindrical body with tapering ends, of a maximum diameter of 3 m (10 ft); the capacity is 230 metric tons of steel. Each end terminates in a steel shaft resting in a bearing. At one end, enclosed in a casing, is electric turning gear for tilting the mixer. The electricity supply is obtained from a convenient point in the melting or casting shop. Hand gear is also provided as a stand-by. The supporting bearings are mounted on bolsters on two seven-axle trucks, the axle loading being $2^1/_2$ metric tons. The length over the buffers is 23.5 m (77 ft). The mixer can be rotated through 360 deg by the 10-hp motor of the turning gear, taking between 9 and 10 min for a complete turn. In the Phoenix-Rheinrohr Steelworks they are known among the workmen as "Flor Finas Ludwig Erhard" (the manager's favorite cigar).

Hot-metal mixer with a capacity of 230 metric tons made by Junkerather Maschinenfabrik G.m.b.H. shown at German Industries Fair

Substance in Brief of Papers Presented at ASME Meetings

ELEANOR RAMP
Edit. Asst.

ASME TECHNICAL DIGEST

Production Engineering

On the Mechanics of Shear-Spinning.. 60—Prod-1... By Serope Kalpakcioglu, The Cincinnati Milling Machine Company, Cincinnati, Ohio. 1960 ASME Production Engineering Conference paper (multilithographed; to be published in **Trans. ASME—J. Engng. for Indus.**; available to March 1, 1961).

Metal spinning, like many other forming operations, is to the present day still mostly an art; the techniques involved in manufacturing a good product have been developed through long experience by trial-and-error methods.

Until a few years ago much of the industrial experience was in hand spinning, but with the advent of power spinning a new set of problems was created.

Because of the advantages of the power-spinning process over other methods of manufacturing the same part, and because of the success obtained so far in many applications and with materials of widely varying properties, it is apparent that power spinning is a very promising process.

Its main advantages are that parts with rotational symmetry can be spun in a rather short time with hardly any waste of material and with greatly improved mechanical properties of the final product over those of the initial material.

In recent years power spinning has been playing a very important role in the manufacturing of nose cones and missile parts of various forms. This paper deals with an analytical study of the mechanics of the shear-spinning process; i.e., cone spinning, as obtained from an idealized model of the operation.

Some of the basic quantities in the shearing mechanism are defined and formulated: shear strain, shear-strain rate, specific energy, and tangential force (torque) in spinning.

An experimental technique to study metal flow in shear spinning is described and the results of analytical work are compared with experimental data. The technique described to study metal flow in spinning can be employed to find the influence of process variables on the flow pattern.

Free Machining Steel, Part I—Tool-Life Characteristics of Resulfurized Steel.. 60—Prod-2... By M. C. Shaw, Mem. ASME, P. A. Smith, Mem. ASME, and N. H. Cook, Massachusetts Institute of Technology, Cambridge, Mass. 1960 ASME Production Engineering Conference paper (multilithographed; available to March 1, 1961).

Tool-wear and tool-life characteristics of a series of five steels of different sulfur content are presented for different values of cutting speed, feed, cutting fluid, and cold-work.

While the presence of manganese sulfide in steel is generally found to extend tool life, certain combinations of speed and feed yield results that indicate the reverse effect.

For the group of hot-rolled steels studied, sulfur was found to shorten tool life at certain cutting speeds when the feed was in the vicinity of 0.005 ipr.

The hot-rolled steels of low sulfur content exhibit better tool life with high-speed-steel tools than with carbide tools when the cutting speed is such as to give a tool life in the vicinity of four hours.

A tracer device is described that is useful in exploring the nature and extent of the crater and build-up areas on the tool face.

Free Machining Steel, Part II—Tool-Life Characteristics of Leaded Steel..60—Prod-4... By M. C. Shaw, Mem. ASME, P. A. Smith, Mem. ASME, and N. H. Cook, Massachusetts Institute of Technology, Cambridge, Mass. 1960 ASME Production Engineering Conference paper (multilithographed; available to March 1, 1961).

High-speed-steel tool-life results are presented and discussed for a leaded and nonleaded steel from the same heat. Variables investigated include cutting speed, feed, cutting fluid, and cold-work.

Conclusions were drawn as follows:

1 Addition of lead was found to improve the machinability (V_{60}) of the killed low-carbon steel studied by about 30 per cent when in the hot-rolled condition and by as much as 20 per cent when in the cold-drawn condition.

2 Cold-drawing was found to improve the tool life of the leaded steel.

3 Use of a water-base cutting fluid was found to *decrease* the machinability (V_{60}) of the nonleaded steel by 28 per cent and of the leaded steel by 32 per cent.

4 The cold-drawn nonleaded steel produced chips of periodically varying thickness over a certain speed range (200–300 fpm), and this fluctuation in chip thickness was reflected in a decrease in tool life. Lead was found to completely suppress this instability in chip formation.

5 An optimum tool-chip contact length appears to exist for which the tool life will be a maximum at a given speed. It is possible to reduce the contact length to a value below the optimum by providing too much lead, too much chip cooling, too much cold-work, or a combination of these effects. The tool-face crater-tracing device employed in this study is useful in ascertaining the tool-chip contact length pertaining for any situation.

6 Lead was found to become less effective with increased feed rate.

A New Test Method for Determination of Spinnability of Metals..60—Prod-3... By R. L. Kegg, Assoc. Mem. ASME, Cincinnati Milling Machine Company, Cincinnati, Ohio. 1960 ASME Production Engineering Conference paper (in type; to be published in **Trans. ASME—J. Engng. for Indus.**; available to March 1, 1961).

One of the greatest applications of the shear-spinning process is the forming of aircraft and missile components, many of which are of newly developed alloys having good high-temperature structural properties but limited room-temperature ductilities. Because there has been no well-defined method to predict whether or not a particular material could be

shear spun to a particular shape without fracture, the author's company investigated a method whereby manufacturers who employ shear spinning might have some method to test the spinnability of their materials at a minimum cost.

The new test described uses a spinning mandrel mounted on a shear-spinning machine. Work done to date with this test method indicates that a good non-spinning criterion for estimating spinnability (the ability to undergo shear-spinning deformation, without fracture) is the tensile reduction of area at fracture. Results of the spinnability test suggest that a feature of this test be adopted in the design of production cone-spinning mandrels. A qualitative discussion of the effects of deviating from the sine law is presented.

Conclusions drawn are:

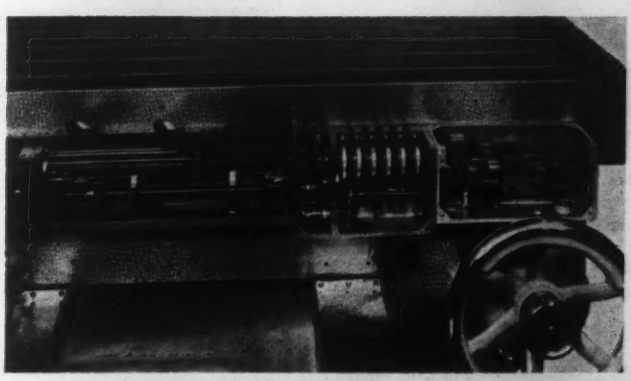
1 The ellipsoidal mandrel can be used to test the spinnability of materials.

2 The spinnability of most materials may be predicted from the tensile test reduction of area. This is possible through the empirical relationship given herein.

3 The average per cent elongation from the tensile test cannot be used by itself to estimate spinnability.

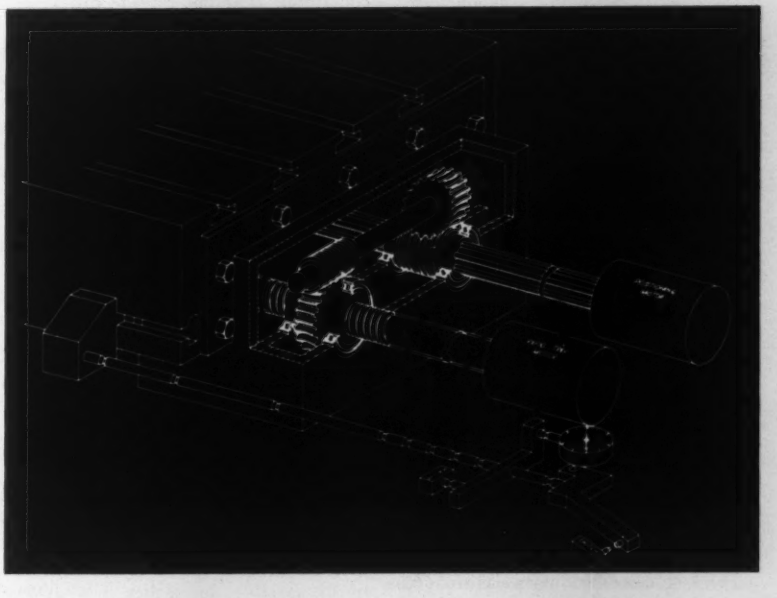
4 Greater deformation is possible when spinning to a thickness less than that required by the sine law, and less deformation is possible with a thickness greater than sine-law thickness.

5 Greater reductions should be possible in the spinning of cones if a round-nosed mandrel is used and the thickness on this nose is controlled to obey the sine law at each point. This will eliminate bending and sudden changes in section which may be detrimental to the operation.



Direct dimension-measuring system mounted on jig borer, **above**, and operator setting dimensions on standard jig borer without numerical control, **right**. (60—Prod-10)

Automatic positioning device showing switching mechanism and compound worm and worm-wheel reduction box which provides slow positioning speed (60—Prod-10)



Three-Axis Numerical Control of a Precision Boring Machine..60—Prod-10... By C. R. Hibbard, The Fosdick Machine Tool Company, Cincinnati, Ohio. 1960 ASME Production Engineering Conference paper (multilithographed; available to March 1, 1961).

Production requirements in metalworking are continually demanding closer tolerances along with smaller production runs. Small production runs combined with close tolerances invariably mean a greater percentage of direct labor cost and higher tooling cost per piece.

The pressure for cost reduction of this type has stimulated the development of numerically controlled machine tools.

This paper describes the application of a unique measuring system and control system to a conventional jig borer. When the trend toward numerical control began to appear, the Fosmatic jig borer was designed to not only accept numerical control but to anticipate changing production requirements.

It was necessary to design a machine with electrical controls to all machine functions (speeds, feeds, spindle start and stop, spindle feed engagement, spindle rapid advance and retract, table and saddle clamping, and so on) and with an extremely accurate measuring device which would be simple in operation from the standpoint of a standard jig borer and which could be operated by remote control.

The direct dimension-measuring system that was designed to meet these requirements provides a mechanical method of establishing co-ordinate dimensions by aligning selected Class A gages. This system completely eliminates all gage handling. The measuring unit is totally enclosed to avoid entrance of foreign material; there is no sliding contact between the measuring surfaces of the gages.

This precision boring machine incorporates a mechanical measuring system, an electromechanical positioning system, and an electromechanical remote-control system relying primarily on straightforward electrical circuits. It is believed to be an important step toward simplification and ease of maintenance while providing speed of operation and an extremely high order of precision.

On the Analysis of Random Errors in Precision Grinding Operations..60—Prod-7...By R. S. Hahn, Mem. ASME, Heald Machine Company, Worcester, Mass. 1960 ASME Production Engineering Conference paper (in type; to be published in **Trans. ASME—J. Engng. for Indus.**; available to March 1, 1961).

The concept of random variables as used in the theory of probability is applied to machining operations, in which the input stock, hardness, stock distributions, and so on, vary. Output errors are calculated in terms of input variations and machining time, specifically for grinding operations. In particular, output size errors are related to input stock variations as well as variations of wheel sharpness.

Variations in runout or eccentricity are related to the initial runout and stock. A dimensionless variable for comparing metal-cutting machine tools is also introduced which permits an estimate of elastically produced errors. Transient forces on grinding wheels are also considered.

Machinability of Nodular Cast Irons—Part I: Tool Forces and Flank Adhesion ..60—Prod-8...By I. Ham, Assoc. Mem. ASME, K. Hitomi, and G. L. Thuering, Mem. ASME, The Pennsylvania State University, University Park, Pa. 1960 ASME Production Engineering Conference paper (in type; to be published in **Trans. ASME—J. Engng. for Indus.**; available to March 1, 1961).

Nodular (ductile) cast iron is a relatively new material, developed as recently as 1948. Because it can be produced as easily as cast iron but has physical properties similar to those of cast steel, nodular cast iron is finding increased use as an engineering material.

Three grades of nodular cast iron (60, 80, and 100) were tested to determine the cutting and feed forces required to machine the materials, to determine the performance of several grades of carbide and oxide cutting tools, and to investigate the flank adhesion phenomenon.

It was found that:

1 Nodular cast irons grade 80 and grade 100 machine in a manner similar to high-strength gray cast iron.

2 The cutting forces and net horsepower required for machining grade 80 are approximately 5 per cent less and, for grade 60, 10 per cent less than the force for grade 100.

3 When grade 60 nodular cast iron is machined with carbides, there is a critical speed at which an unusual flank adhesion (build-up) occurs, producing a sudden increase in tool forces. The speed at which this occurs and the magnitude of the increase depend on the cutting tool material.

4 The speed at which flank adhesion occurs decreases as the titanium or TiC content of the cutting tool increases. However, the magnitude of the force increase is less with tools that are high in titanium, and at high speeds (800 fpm to 1000 fpm) the build-up decreases to negligible amounts.

5 Flank build-up remains the same or grows with increases in speed when grade 60 is machined with straight tungsten carbide tools, but does not occur when grade 60 is machined with oxide tools.

6 The occurrence of flank build-up with carbides, and the decrease of build-up at high speeds when grade 60 nodular iron is machined with tools containing titanium carbide can be explained by and tend to confirm the oxide film theory. The absence of build-up with oxide tools also confirms this.

Some Physiological Effects of Low-Frequency, High-Amplitude Vibration..60—Prod-17...By M. A. Schmitz and C. A. Boettcher, Bostrom Research Laboratories, Milwaukee, Wis. 1960 ASME Production Engineering Conference paper (multilithographed; available to March 1, 1961).

Within the past 50 years tremendous strides have been taken in development and production within the transportation industry—in the form of the automobile, truck, tractor, airplane, helicopter, and space craft.

Each, however, is inflicted with a common, undesirable factor—low-frequency, high-amplitude, whole-body vibration—which has become a relatively recent subject of interest to researchers. There is no question as to the existence of this variable; but rather, in what way and to what extent does this variable affect human performance?

When the human body is subjected to vibration at a constant amplitude, e.g., 1 in., with frequencies of from 1 to 6 cps, its rate of acceleration varies with the input frequency. This principle has given rise to a measure of "transmissibility" defined as the output over input. Using this measure, it has been established that, on the average, man tends to resonate at a frequency between $3^1/_2$ to 5 cps.

The purpose of the study reported in the paper was to investigate some of the physiological effects of vibration on human and animal subjects within the range of 1 to 8 cps.

The following physiological measures were taken on the three dogs: (*a*) Blood pressure in the right atrium of the heart; (*b*) blood pressure in the right ventricle of the heart; (*c*) blood pressure in the left ventricle of the heart; (*d*) blood pressure in the aorta at heart level; (*e*) heart rate; and (*f*) cardiac output.

Blood pressure and heart rate were the measures taken on the human subject.

The results of the exploratory physiological studies in general showed evidence of the following changes:

1 An increase in systolic and a decrease in diastolic pressure in the aorta, and right atrium in anesthetized dogs.

2 An increase in systolic pressure in man but no appreciable change in diastolic pressure.

3 An increase in cardiac output.

4 Large variations in pulse pressure.

5 No appreciable change in heart rate.

All changes appeared to be a function of frequency of vibration as well as intensity of vibration.

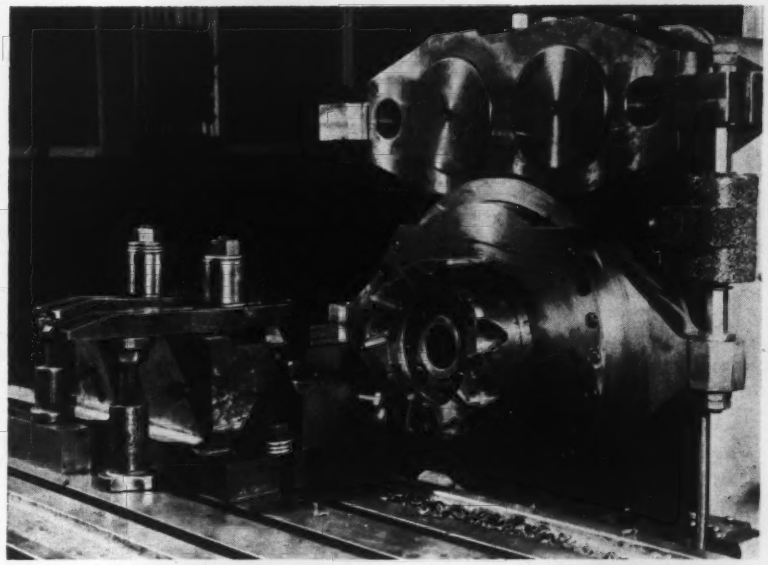
A Milling Torquemeter of Planetary-Gear Design..60—Prod-5...By J. R. Roubik, Assoc. Mem. ASME, Kearney and Trecker Corporation, Milwaukee, Wis. 1960 ASME Production Engineering Conference paper (multilithographed; to be published in **Trans. ASME—J. Engng. for Indus.**; available to March 1, 1961).

For experimental research in milling it is desirable to have a device capable of measuring tangential cutting force with a high degree of accuracy and sensitivity over a broad range of laboratory and shop conditions with single-point or multiple-point milling cutters of various sizes and geometries.

A design of planetary-gear dynamometer or torquemeter, to measure tangential cutting forces in milling with a high degree of accuracy and sensitivity, is described together with certain design considerations and limitations as well as associated force-measuring equipment.

This device is a highly efficient, sensitive, and durable research tool for use in accurately determining the magnitude and manner of variation of the cutting force, energy, and power at the cutting edges of single-point or multiple-point milling cutters, as well as machine efficiency, in full-scale milling operations.

Procedures and methods of determining values of tangential cutting force, specific cutting energy, and horsepower at the cutter from cutting-test data obtained



Cutting test setup with torquemeter and load cell. Major part of torquemeter in this view constitutes the lever arm, attached to the fixed sun gear, which is constrained by the load cell at the right. Cell is rigidly attached to reaction member on machine overarms. Tensile loading of cell is preferred and is obtained with cell on right-hand side for right-hand cutters as shown. (60–Prod-5)

with the torquemeter are given with examples.

Design estimates indicate a gearing efficiency of greater than 99 per cent, and experimental determinations at 220 rpm input speed confirmed this high efficiency.

Mean tangential cutting forces in milling, as well as the manner of force variation during the cutting sweep of one or more milling teeth forming chips of varying thickness, can be determined accurately.

With careful power-input measurements, milling-machine efficiencies in actual cuts can be evaluated accurately, and comparison of various models of milling machines can be made with ease.

Metals Engineering

Energy Versus Stress Theories for Combined Stress—A Fatigue Experiment Using a Rotating Disk..60—Met-1... By W. N. Findley, Mem. ASME, Brown University, Providence, R. I.; P. N. Mathur, Assoc. Mem. ASME, Ford Motor Company, Dearborn, Mich.; E. Szczepanski, Brown University, Providence, R. I.; and A. O. Temel, Robert College, Istanbul, Turkey. 1960 ASME-AWS Metals Engineering Conference paper (multilithographed; to be published in **Trans. ASME—J. Basic Engng.**; available to Feb. 1, 1961).

An experiment is described in which the strain energy at the critical location for fatigue failure is maintained constant while the stresses on a given plane of the material at the same location are caused to fluctuate.

Apparatus developed to produce this condition consisted of a circular disk with a wide-flanged rim which was loaded along a diameter by means of pivot-pad bearings. The disk was then rotated under a constant load to produce the desired fluctuation in stresses at the center of the disk while maintaining a constant strain energy at the center.

The material selected for the test specimen was 355-T61 cast-aluminum alloy, a material having a fairly low fatigue strength. Silicone-base oils having a flat viscosity-temperature curve were tried for lubrication of the loading pads until Dow-Corning 200 fluid blended to a viscosity of 300 cs was found satisfactory.

The procedure employed was to insert the specimen, start it rotating at a speed of 3500 rpm (2100 rpm for the last test), and then apply the load rapidly. After the load had been applied for a given interval, it was removed, the machine stopped to allow it to cool, and the specimen was removed and inspected for cracks.

In order to determine the extent of the area of the disk over which the stresses and the strain energy were nearly constant in magnitude, stress analyses by means of photoelasticity and strain gage were employed. Fatigue cracks were produced in the disk specimens in spite of the fact that there was no fluctuation in the applied strain energy at the critical location during the tests of these specimens.

In view of the fact that fatigue cracks were produced in regions in which the strain energy was essentially constant during the test, it was evident that fluctuating strain energy could not be the prime cause of fatigue failure.

Conversely, it was inferred that fatigue failure must result from fluctuation of some component of stress or strain referred to particular planes of the material, such as a critical shear stress.

Micro-Plastic Strain Hysteresis Energy as a Criterion for Fatigue Fracture.. 60—Met-2... By C. E. Feltner and JoDean Morrow, University of Illinois, Urbana, Ill. 1960 ASME-AWS Metals Engineering Conference paper (multilithographed; to be published in **Trans. ASME—J. Basic Engng.**; available to Feb. 1, 1961).

An energy criterion for fatigue failure is postulated. The paper represents a preliminary attempt to measure directly the micro-inelastic strains which are present near the fatigue limit, with the intention of correlating the plastic-strain hysteresis energy with fatigue behavior.

The scope of this investigation covers the testing of eight SAE 4340 steel specimens in an axial fatigue machine under conditions of controlled stress. True stress-true strain information was obtained for the same material.

For the material used in this particular investigation it may be concluded that: (*a*) Plastic-strain hysteresis energy provides a basis for the prediction of the S-N curve obtained; (*b*) the static true stress-strain curve provides the necessary information to predict fatigue life for stress amplitudes near and slightly above the fatigue limit; (*c*) cyclic stress-strain measurements serve to elucidate two facts:

1 The rapid growth of the hysteresis loop in the high fatigue-stress region accounts for the erroneous prediction of longer lives than actually measured.

2 The slight decay of hysteresis energy for stresses at or below the fatigue limit demonstrates that damaging plastic-strain hysteresis energy dies out due to cyclic strain-hardening before the critical total plastic energy to cause fracture is accumulated.

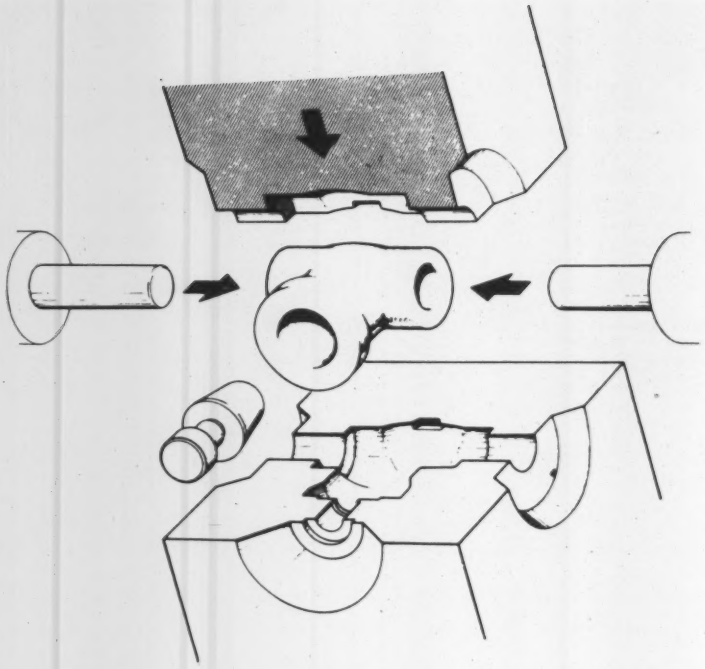
Future investigations should be extended to a variety of materials to investigate further the validity of microplastic-strain hysteresis energy as a criterion for fatigue fracture.

Fracture of Flat and Curved Aluminum Sheets With Stiffeners Parallel to the Crack..60—Met-3... By J. Frisch, Assoc. Mem. ASME, University of California, Berkeley, Calif. 1960 ASME-AWS Metals Engineering Conference paper (multilithographed; to be published in **Trans. ASME—J. Basic Engng.**; available to Feb. 1, 1961).

The study of crack propagation and fracture in engineering structures involves the consideration of a large number of parameters. Experiments and results of a phenomenological study of the crack growth and failure conditions in 0.040-in-thick 2024-T3 clad aluminum sheets with riveted J-stiffeners parallel to an existing crack are described. The effect of the spacing of stiffeners having two different thicknesses, namely, 0.032 in. and 0.072 in., as well as location of the crack relative to the stiffeners, are observed.

Curved specimens with a 69-in. radius of curvature as well as flat panels were subjected to uniaxial tension perpendicular to a simulated crack to study the effects of curvature, crack location, and stiffener spacing.

Increase in strength due to stiffening particularly in the curved panels was observed, although these specimens exhibited considerably lower crack strength than flat ones. For the specimens tested, crack location as well as variations of stiffener spacing from 3 to 12 in. had no appreciable effect on either critical crack length or failure stress.



Schematic illustration of forging dies and multiple-ram action in forging 14-in. Inconel gate-valve body (60–Met-5)

Nickel-Chromium-Iron Alloy (Inconel) Forgings for Nuclear-Reactor Systems—A Summary of Forging Techniques and Mechanical Properties..60—Met-5... By C. L. Dotson and R. L. Roshong, Cameron Iron Works, Inc., Houston, Texas. 1960 ASME-AWS Metals Engineering Conference paper (multilithographed; available to Feb. 1, 1961).

One of the most important design considerations for nuclear-reactor systems is the proper selection of materials which most adequately fill all the requirements for a specific application. The material must be economically available and susceptible of fabrication into a useful form.

A development program was initiated to investigate the attainable strength levels of Inconel, a nickel-base corrosion-resistant alloy, in heavy forged sections, which has resulted in forging techniques and thermal treatments capable of consistently exceeding the customer's requirement of 30,000 psi, 0.2 per cent offset yield strength, and 80,000 psi ultimate tensile strength with 35 per cent reduction of area.

Consequently, several Inconel forgings weighing up to 3150 lb have been produced for use in nuclear reactors. This paper reviews the forging characteristics of Inconel and the metallurgical properties of several forgings produced for use in nuclear systems.

Techniques for producing intricately forged shapes using multiple-ram forging presses are discussed. Mechanical properties were determined and are reported. Ultimate strength levels as high as 90,000 psi and 0.2 per cent offset yield strengths as high as 45,000 psi were produced in heavy forged sections. Forgings of comparable sections produced by conventional methods normally have ultimate and yield strengths of the order of 80,000 and 28,000 psi.

Arc Welding of a Ni-Cr-Fe (Inconel) Alloy for Nuclear Power Plants..60—Met-6... By Jay Bland and W. A. Owczarski, General Electric Company, Schenectady, N. Y. 1960 ASME-AWS Metals Engineering Conference paper (multilithographed; available to Feb. 1, 1961).

The use of a high nickel, Ni-Cr-Fe alloy (Inconel) is being considered in nuclear power plants because it has stress-corrosion resistance in certain media which is superior to the austenitic stainless steels. The fabricating of this alloy will require its welding for structural members and for overlaying carbon steel, with Inconel type filler metals.

This paper describes the results of an investigation which has been made of the arc welding of Inconel, using commercially available filler metals and the shielded metal arc, inert-gas tungsten-arc, and inert-gas metal-arc welding processes.

Weldments meeting the high-quality standards required for nuclear power-plant service can be made with all of the filler metals and processes studied.

In general, all structural welds of Inconel to itself, to Type 304 stainless steel, or to carbon steel failed in the weaker base metal when tested for static tensile properties. All-weld-metal mechanical properties of the Inconel type filler metals exceeded those of the annealed wrought-base metal.

Fabrication of a One-Inch Thick Ten-Inch Diameter Welded Inconel Pipe..60—Met-7... By W. L. Fleischmann, Mem. ASME, Knolls Atomic Power Laboratory, Schenectady, N. Y.; and R. F. Gurnea, Midwest Piping Company, Inc., St. Louis, Mo. 1960 ASME-AWS Metals Engineering Conference paper (multilithographed; available to Feb. 1, 1961).

This paper gives the mechanical and metallurgical data taken on specimens of Inconel plate and pipe after the various heating and forming operations involved in making of a fabricated pipe.

The fabricated pipe meets the mechanical requirements of the Inconel plate Specification Sb-168 of the ASME Boiler and Pressure Vessel Code and the quality requirements of welded pipe as stipulated in ASTM A358-56T specification for

Electric-Fusion-Welded Austenitic Chromium-Nickel Alloy Steel Pipe for High Temperature Service.

The particular plate discussed in this paper was sensitive to the welding process used. Welding with coated electrodes and the TIG process produced sound welds while the heat-affected zone of the weld made by the MIG process showed fissures. These fissures are associated with segregate regions in the base metal.

The Use of the Center Notch-Tensile Test to Evaluate Rocket-Chamber Materials..60—Met-8... By J. J. Warga, Aerojet-General Corporation, Sacramento, Calif. 1960 ASME-AWS Metals Engineering Conference paper (multilithographed; available to Feb. 1, 1961).

Evaluation of materials for solid rocket-chamber use by means of the center notch-tensile test proposed by Irwin and Kies has been performed and an order of merit has been established for alloy steels, based on the equivalence of net section stress and yield strength.

Furthermore, the use of the test to determine the effects of heat-treatment, rolling, welding, melting techniques, and cold-working is described, and it is shown that the test is valuable in the selection of processing and fabricating procedures for the manufacture of rocket-chamber materials and the fabrication of chambers.

Finally, it is shown that alloys can be designed for high specific fracture toughnesses and, by inference, the development of alloy steels of high strength combined with high resistance to crack propagation is demonstrated to be feasible.

Brittle Fracture Characteristics of a Reactor Pressure Vessel Steel..60—Met-9... By E. T. Wessel and W. H. Pryle, Westinghouse Research Laboratories, Pittsburgh, Pa. 1960 ASME-AWS Metals Engineering Conference paper (multilithographed; available to Feb. 1, 1961).

The brittle-fracture characteristics of Type ASTM A302B steel were determined with material from a 7-in-thick plate for both the as-received (normalized) condition and after a heat-treatment consistent with the thermal cycles encountered during the fabrication of a reactor pressure vessel.

The heat-treated steel was found to be slightly more notch sensitive and had a somewhat higher transition temperature than the as-received steel. In comparison with other steels that have been studied under similar conditions, the A302B steel was found to be considerably more brittle-fracture resistant.

Average applied stresses in excess of the normally measured yield strength were required to cause fracture in the A302B steel even in the presence of a pre-existing large crack at temperatures above −150 F. Other steels tested similarly fractured at a fraction of the yield strength at much higher temperatures.

Crack Propagation in Thin Metal Sheet Under Repeated Loading..60—Met-11... By H. W. Liu, University of Illinois, Urbana, Ill. 1960 ASME-AWS Metals Engineering Conference paper (multilithographed; to be published in **Trans. ASME—J. Basic Engng.**; available to Feb. 1, 1961).

An experimental and analytical investigation was undertaken to study the fundamental factors of crack propagation in a thin metal sheet under repeated axial loading. Sheet specimens of 2024-T3 aluminum alloy containing a central hole were used in the experimental investigation.

Stress range and mean stress were the controlled parameters. An expression for crack length was derived, based on the concept of geometric similarity of crack configuration, for a semi-infinite sheet subjected to repeated loads consisting of a constant stress and mean stress.

The expression is in terms of a stress-dependent propagation factor and an exponential function of the number of cycles of loading. The expression for a semi-infinite sheet was modified for crack propagation in a specimen of finite width. Accurate prediction of the propagation life was possible using the modified equation. Photomicrographic observations of the crack tips were made.

A Study of Theories of Fracture Under Combined Stresses..60—Met-4... By I. Cornet and R. C. Grassi, Mem. ASME, University of California, Berkeley, Calif. 1960 ASME-AWS Metals Engineering Conference paper (multilithographed; to be published in **Trans. ASME—J. Basic Engng.**; available to Feb. 1, 1961).

Experimental data are presented for a cast nodular iron and for high-silicon cast-iron materials which represent limiting conditions of ductility in a test of fracture theories. Data of other pertinent investigations are reviewed and various theories are discussed with regard to their applicability.

It is concluded that failure under combined stresses of brittle materials can be predicted adequately by applying a notch-modified-distortion-energy criterion. However, other criteria are also applicable.

Since criteria for the failure of brittle materials are conspicuously phenomenological, the application of solid-state and dislocation theory, to explain the initiation and growth of a crack in a heterogeneous structure under combined stresses, has been discussed.

Recent Advances in Dispersion Strengthened Metal-Metal Oxide Structures..60—Met-12... By K. M. Zwilsky, New England Materials Laboratory, Medford, Mass.; and N. J. Grant, Massachusetts Institute of Technology, Cambridge, Mass 1960 ASME-AWS Metals Engineering Conference paper (multilithographed; available to Feb. 1, 1961).

Dispersion strengthening and hardening means of strengthening metals have actual and potential advantages over more conventional means of strengthening, such as cold-working or solid-solution alloying. These advantages lie in the high-temperature strength and structure and property stability achieved with fine particle dispersions.

Dispersion hardening is achieved through the dispersion of an inert, hard, strong second phase, which may be metallic, intermetallic, or nonmetallic. The second phase must be of submicron size uniformly dispersed in the ductile metal matrix.

Storage of energy, obtained by a high strain rate deformation process, then produces a strong structure which is unusually resistant to recovery and recrystallization processes even at temperatures approaching the melting of transformation temperature of the metal or alloy matrix.

Dispersion-strengthened alloys produced by mechanical mixing and internal oxidation are reviewed for the following alloy systems: (*a*) Copper-metal oxide alloys; (*b*) nickel-base alloys; (*c*) cobalt-metal oxide alloys; (*d*) titanium-base alloys; and (*e*) molybdenum-metal oxide alloys.

Improvements in strength properties over the pure metal vary from a factor of 5 to 20, depending on the particle size, the nature of the dispersoid, the temperature, and the time factors involved.

The best alloys obtained so far show high-temperature strength properties which are superior to those obtained in age-hardened alloys based on the same alloy systems.

Maintenance and Plant Engineering

Maintenance Control Procedures for Industrial Lift Trucks..60—MPE-1... By J. M. Squier, Clark Equipment Company, Battle Creek, Mich. 1960 ASME Maintenance and Plant Engineering Conference paper (multilithographed; available to Feb. 1, 1961).

This paper reveals the role carefully kept maintenance records can play in

reducing maintenance costs and down time, in prolonging the life of materials-handling equipment, in affording production efficiencies by minimizing unscheduled service repairs, in providing the fullest and wisest utility of equipment, and even, in some cases, in reducing the number of lift trucks needed for materials handling.

Records used as a normal part of a daily routine can reveal which trucks are being overworked and can be used to determine costs of over-all operation and of each truck. Records of each truck can be used to analyze minor troubles, prescribe preventive measures which will eliminate major work, and rate performance of mechanics.

The type of records, how to keep them, and how to police them, are points also covered to provide valuable guides toward better materials handling.

Maintenance Men—Important Today, A Necessity Tomorrow..60—MPE-6... By John Vonderheide, General Electric Company, Louisville, Ky. 1960 ASME Maintenance and Plant Engineering Conference paper (multilithographed; available to Feb. 1, 1961).

The importance of the maintenance field has increased considerably in the past few years, but need for futher attention to methods of organizing the maintenance function is indicated. This is necessary if satisfactory progress toward achieving increased productivity is to be attained.

Some major industrial efforts toward preventive maintenance have not proved too successful owing to emphasis on preplanned schedules and without regard to internal limitations.

The problems raised in conjunction with a planned maintenance program are quite numerous and raise real questions of concern.

This paper describes the organization, operation, and benefits of a maintenance organization in which the employees in maintenance have a broad range of skills instead of the usual craft specialization.

Tests and Inspections—Are You Getting the Plant You Want, and Paid For?..60—MPE-7... By R. M. Maxin, Mem. ASME, Day and Zimmermann, Inc., Philadelphia, Pa. 1960 ASME Maintenance and Plant Engineering Conference paper (multilithographed; available to Feb. 1, 1961).

The operating time and money saved through systematic inspection procedures are sufficient to pay the cost for medium-sized to large installations. Even for small companies which cannot justify an inspection group, attention to the factors pointed out in the paper by someone in the organization will pay dividends in savings.

The benefits from systematic inspection procedures are not, however, confined to simply spotting defective equipment before it is too late. Inspection planning and execution require attention to all phases of the job from planning and design to installation and start-up.

Following is a partial list of the profitable results of the inspector's activities, as well as some of the corollary advantages: (*a*) Good liaison between management and contractor; (*b*) preliminary inspection of equipment prior to erection; (*c*) thorough inspection at the site; (*d*) proper installation in compliance with drawings; (*e*) proper material used in compliance with specifications; (*f*) up-to-date drawings as a result of changes made in the field; (*g*) progress reports of work completed; (*h*) planning of future manpower requirements, based on completed work; (*i*) establishment of test procedures and test media which can be used for future projects; (*j*) maintenance of close check on contractor's progress reports; (*k*) final closure of the project expedited.

Maintenance Considerations for Electric-Powered Industrial Trucks..60—MPE-2... By H. C. Bennett, Lewis-Shepard Company, Watertown, Mass. 1960 ASME Maintenance and Plant Engineering Conference paper (multilithographed; available to Feb. 1, 1961).

There is a need for a realistic re-evaluation of the maintenance service in rapidly expanding modern industries. This is particularly true of the moderate to small manufacturing and warehousing groups.

The electric-powered industrial truck is often an integral part of these industries. Like other equipment it requires maintenance.

By acquainting management and supervisory personnel with some of the truck details, problems, and the service required to maintain effectiveness, it is the intention of this paper to stimulate action toward better planned maintenance programs, resulting in better performance with lower costs.

Inherent in most of the approaches to maintenance programming is preventive maintenance, the objective of which is to identify and take action to avoid costly down time.

Coverage includes selecting the type of maintenance program, and putting the program into effect with the proper use of a supervisor, a check list, and a good record file.

In the electric-powered industrial truck the basic areas requiring planned maintenance are: mechanical, hydraulic, and electrical. Maintenance procedures in these areas are discussed.

Maintenance of Bulk Material Conveying Equipment..60—MPE-5... By C. W. Cassells and E. J. Kamp, Link-Belt Company, Chicago, Ill. 1960 ASME Maintenance and Plant Engineering Conference paper (multilithographed; available to Feb. 1, 1961).

As a result of a total of 42 years of field experience in the installation of materials-handling equipment in all manner of industries, the authors have become aware of both the needs and shortcomings of preventive maintenance by American industry.

Preventive maintenance, they feel, begins on the drawing board, and maintenance and production men should be consulted while a machine is still in the "talk" stage and when it can be designed for easiest, fastest, and most economical planned preventive maintenance. A design check list should be provided with considerations before designing or buying a new piece of machinery or equipment.

Maintenance areas for belt conveyers, the work horses of industry, are pinpointed, and methods of cleaning belts are covered. The authors give time-saving tips for maintenance and emphasize the vital part lubrication plays in preventive maintenance. They believe that the old-fashioned oiler or grease monkey is outmoded and should be replaced by a first-class mechanic who can make preventive maintenance more meaningful to industry.

Industrial Lighting..60—MPE-3... By Vern Kempf, Plant Engineering Magazine, Barrington, Ill. 1960 ASME Maintenance and Plant Engineering Conference paper (multilithographed; available to Feb. 1, 1961).

This is a brief review of the four fundamental factors involved in every visual task: (*a*) Size, not necessarily the size of the object as much as the size of the particular task; (*b*) contrast, since to be easily seen the details of an object must differ in reflectance or color from the surrounding background; (*c*) brightness, which is related to the amount of light in the background; (*d*) time, the element of seeing involved in many inspection operations where minute flaws have to be detected at a glance.

The many items that enter into every lighting calculation and how they can influence the over-all cost of light are discussed. Design aspects of industrial lighting are covered, keeping in mind the quantity and quality of light as two separate things.

The best general lighting lamp of all three lamp types—filament, mercury, and fluorescent—are considered with respect to cost.

Coefficient of utilization, the ratio of the lumens reaching the working plane, a factor that takes into account the efficiency and distribution of the luminaire, its mounting height, the room proportions, and the reflectance of walls, ceiling, and floor, is examined.

Cost figures are presented to demonstrate the cheapest way to maintain a given lighting level.

Oil and Gas Power

Horsepower to Heat the Nation..60—OGP-3...By R. S. Jefferies, New York State Natural Gas Corporation, Pittsburgh, Pa. 1960 ASME Oil and Gas Power Conference paper (multilithographed; available to March 1, 1961).

Requirements for horsepower in the heating industry are great. Natural gas, a natural resource of organic origin, is being used more extensively to provide fuel for the space-heating market. Power installations on long pipelines over the past two decades have moved natural gas, an efficient, economical fuel, to all parts of our country.

The growth of the natural-gas industry is briefly traced, covering early development of the oil and gas industry in the Appalachian area, giving gas-pipeline statistics, and showing the growing requirements for gas storage to meet market demands.

General power requirements and compressor functions are outlined. Two general types of compressors are used in gas operations—the centrifugal and the displacement compressor. Generally, for production work, reciprocating compressors are desirable. For pipeline service, either the centrifugal or the reciprocating machine can be used.

The method of determining required storage-pool operations is discussed and the compressor-design problems involved are covered. Station gas-piping systems and operating costs are covered. Comparison is made of the economic value of storage capacity versus pipeline capacity.

Development of a Speed and Load-Sensing Governor..60—OGP-4...By G. W. Taylor, Mem. ASME, Woodward Governor Company, Rockford, Ill. 1960 ASME Oil and Gas Power Conference paper (multilithographed; available to March 1, 1961).

Design philosophy followed in selecting one of several methods of accomplishing precise speed control of a prime mover is discussed; a description of how the governor works and a report on results obtained in the laboratory and in the field are included.

Limited only by the stability, noise level, and linearity of amplifiers, electric speed-sensing can have extremely fine resolution and high sensitivity. Negative feedback, transient or permanent, can be introduced by simple methods.

Acceleration sensing opens up a new and attractive means of stabilizing a governor. The experienced governor designer knows the difficulty of designing an accurate, friction-free, long-life governor ballhead and pilot-valve combination, one that will continue accurate in spite of the moisture and dirt-saturated oil sometimes carelessly used in governors.

Whether to use a conventional ballhead with its centrifugal flyweights and spring, plus mechanical or hydraulic stabilizing, or whether to use any of several attractive electrical speed-sensing schemes is not an easy choice.

An equally difficult choice in designing a speed and load-sensing governor is between pulse and scheduling type of load sensing to assist the basic speed sensing which must be used.

Another choice facing the designer is the type of power amplifier or relay which will change the fuel, steam, or other energy input to the prime mover.

In the author's company a hydraulic servo was selected; developing elements of the speed governor and how control improvement was improved are discussed; a description of the operation of the governor is given.

Internal-Combustion Engines in Steam Power Stations..60—OGP-1...By G. C. Boyer, Mem. ASME, Universal Engineering Company, McPherson, Kan. 1960 ASME Oil and Gas Power Conference paper (multilithographed; available to March 1, 1961).

Every electrical utility is confronted with the peak-load problem.

This is a study of the performance of diesel and dual-fuel diesel-engine-driven generating units used for peaking and standby power service in six steam-electric generating plants in Kansas.

While peak loads on all systems formerly occurred in December and January, they are now coming in July, August, and September in those areas where air conditioning is widely used. Besides extra capacity needed due to the increased loads from air conditioning, reliability of generating capacity at all times was necessary.

In 1949, the first diesel-engine generating unit for emergency service was placed in operation in a municipal electric-generating station in Kansas. The unit was housed in a building approximately a block away from the power plant and was used in insure continuity of service for station auxiliaries in the event of electrical power failure in the plant. With the success of this, others were installed in Kansas that have either oil-burning or dual-fuel diesel-generating units supplementing their steam-driven generators.

The first problem in a study of the advisability of adding diesel or dual-fuel engine-generating capacity in a steam-electric station is to determine what function that engine-generating unit must perform. Is it to (*a*) provide a standby source of power for station auxiliaries; (*b*) insure firm capability until additional steam capacity can be installed; or (*c*) be of a capacity such that steam-turbine-driven generators can be base-loaded in parallel with the engine-driven generator carrying the peaks?

Probably the major reason for installing a diesel-engine-driven alternator in an isolated steam-power plant is the necessity to insure operation of electrically driven station auxiliaries at all times.

Determining the engine-driven generating capability needed to provide station firm power during the time when more steam-generating capacity is being added, or selecting the engine-driven generating capability for peaking an existing steam-electric station involves a study of present and probable future station peak loads and the existing generating capability available.

Whether the engine-driven-generating unit should be a straight oil-burning unit or should use dual fuel is another point of consideration.

Cost Comparisons—Diesel and Steam..60—OGP-2...By S. K. Fosholt, Mem. ASME, Stanley Engineering Company, Muscatine, Iowa. 1960 ASME Oil and Gas Power Conference paper (multilithographed; available to March 1, 1961).

Major factors that influence cost of electrical generation by diesel equipment or by steam equipment are presented. These factors are the ones that make up the greatest part of the cost with these two types of generation, and they can vary widely from one case to another. They have a great effect in cost comparisons between the two types of equipment, and consideration of these factors alone may often determine one type of equipment to be considerably more economical than the other.

These factors considered are: (*a*) Fuel cost per net kwhr; (*b*) investment per kw of capacity; (*c*) reserve capacity requirements; (*d*) rate of fixed charges on investment; (*e*) payroll costs; and (*f*) maintenance and other costs.

Illustrations of their general influence on costs are included with their general

descriptions. Consideration is limited to plants in this country having loads up to approximately 30,000 kw without process or heating-steam requirements and with maximum unit sizes of 33,000 kw steam and approximately 5000-kw diesel.

The examples illustrate that changes in basic conditions will materially affect relative costs and that the following effects usually apply:

1 Larger loads favor steam.
2 If reserve capacity requirement is reduced, it favors steam.
3 Higher load factor favors steam.
4 Availability of gas fuel favors diesel.
5 Higher rates of fixed charges favor diesel.

Both types of equipment have their place, and in some situations combination plants can be more economical than either diesel or steam equipment alone.

Piston-Ring Design and Application Practice for Modern Large-Bore Diesel and Gas Engines..60—OGP-6... By F. A. Robbins, Mem. ASME, and J. W. Lippert, Koppers Company, Inc., Baltimore, Md. 1960 ASME Oil and Gas Power Conference paper (multilithographed; available to March 1, 1961).

Increasing demands for higher piston speeds. higher mean effective pressures, turbocharging, and so on, for diesel and gas engines have had a marked effect on the requirements for piston rings, leading to advances in ring design, material, and application.

The purpose of this paper is to define current piston-ring technology as applied to medium and low-speed gas and diesel engines.

An understanding of piston rings as applied to modern engines requires an understanding of the relationship of the rings to the engine conditions for which rings are applied. Piston rings have two basic purposes: (*a*) to seal the combustion gases in the combustion chamber; and (*b*) to meter lubricating oil as required to lubricate the piston and the rings themselves.

The first operating function of piston compression rings is to establish a satisfactory gas seal during the run-in period. This demands that contact be maintained between the face of the rings and the cylinder wall, and the sides of the rings and the ring grooves.

Run-in scuffing is a common problem in internal-combustion engines; and refinements in ring, cylinder, and piston design are required for virtually all new engines to prevent this phenomenon. It is essential that there is good initial oil control.

The single, most common reason for overhaul of internal-combustion engines is the failure of piston rings to perform their required function satisfactorily.

Wear on piston rings is of three types—abrasive, adhesive, and corrosive. Because no ring design or material will simultaneously give optimum protection against all three types of wear, the selection of materials and designs becomes a compromise, taking into consideration the controlling variables of other mating parts, engine design, fuels and lubricants, and operating conditions.

In the paper trends in piston-ring materials, design criteria of compression rings, design of oil-control rings, and typical piston and ring arrangements are discussed.

A Laboratory Gas Engine Lubricant Study..60—OGP-8... By P. M. Coant and L. W. Manley, Socony Mobil Oil Company, Inc., Paulsboro, N. J. 1960 ASME Oil and Gas Power Conference paper (multilithographed; available to March 1, 1961).

For a number of years lubricating-oil viscosity and neutralization number increases in certain gas engines, and to some extent in LPG engines, have been of concern. An initial study was performed in bench tests which demonstrated how oil, contaminated by fuel-decomposition products, can develop high viscosity, NN's, sludge, and varnish deposits.

Then the effect of engine-test variables on oil deterioration and deposits was investigated in a single-cylinder laboratory gas engine with the purpose of developing a convenient gas-engine test for screening promising oil formulations prior to field testing.

The following variables were investigated: (*a*) Blowby; (*b*) air-fuel-mixture ratio; (*c*) load; (*d*) crankcase ventilation; (*e*) oil and water temperatures; and (*f*) fuel composition.

From this study a test procedure representing oil deterioration similar to that obtained in the field has been developed to study the effect of additives and oil composition in gas engines.

Design and Development of Turbochargers for the General Motors Corporation Series 567 Engines..60—OGP-7... By A. N. Addie, Mem. ASME, General Motors Corporation, LaGrange, Ill. 1960 ASME Oil and Gas Power Conference paper (multilithographed; available to March 1, 1961).

Manufacturers of diesel engines have recognized the gains in fuel economy and power output that are attainable by the addition of a turboblower to an engine. Four-cycle-engine manufacturers have been among the first to utilize turbocharging to increase cylinder-charge air density and thereby make possible the burning of additional fuel in the cylinder.

Wide application of the turbocharging principle to two-cycle engines has been comparatively recent because of the necessity of obtaining high turbocharger-component efficiencies and providing positive means for scavenging during starting and acceleration.

This paper describes the design and development of a turbocharger for the 8, 12, and 16-cyl versions of the General Motors Corporation series 567, two-cycle diesel engines, which eliminates the need for a series scavenging blower and provides attractive improvements in power output and fuel economy with minimum penalties in engine weight and cubage.

Requirements of turbocharger are derived from a consideration of the kinds of applications intended for the engine—either railroad diesel-electric locomotive use or stationary power generation.

Determination of the maximum power-design point for the engine and turbocharger system under consideration was influenced by the following factors:

1 Desirable scavenge air pressure drop between engine air box and turbine inlet.
2 Desired engine air box temperature —200 F.
3 Maximum allowable compressor tip speed at altitude using a cast aluminum wheel.
4 Attainable turbocharger combined efficiency without the aid of exhaust-pulse energy.
5 Allowable cylinder peak pressure.

Having established the compressor configuration and the design point, the mechanical design of the turbocharger was developed. It is described in detail.

A discussion is presented of the performance of a prototype 16-cyl engine under condition of constant speed, variable speed, and altitude operation.

Economics of Engine Power Development of the Alco 251 Engine..60—OGP-11... By P. S. Vaughan, Mem. ASME, Alco Products, Inc., Schenectady, N. Y. 1960 ASME Oil and Gas Power Conference paper (multilithographed; available to March 1, 1961).

The effect of engine-design features on many of the over-all costs is described in detail. These factors include first cost, installation cost, fuel cost, and cost of maintenance and repair.

With most designs the first cost is influenced principally by manufacturing facilities. Engines which are produced in quantity from one design can better afford elaborate tooling which permits minimum production costs, and at the same time benefit from the better interchangeability of parts and the better availability of replacement parts. Proba-

bly the greatest single contribution to the reduction of cost and size has been the turbocharger, a part of all Alco 251 engines.

These engines are operated at 900 rpm for 60-cycle, a-c generators, but in other services may be operated at a maximum speed of 1000 rpm.

Included in the discussion of first costs are cost of foundations, the effects of internal moments, and the cost of a building to house the engine.

An important consideration in the excellent thermal efficiency of the diesel engine at full load is fuel economy which is even more favorable in comparison with other forms of power when the load is reduced to 75, 50, or 25 per cent of full load. The 251 engine operating at 192 bmep, and 1750 fpm piston speed, regularly shows a specific fuel consumption on production test of 0.365 lb/bhphr.

The cost of maintenance, one of the most important factors affecting the choice of machinery, can be kept low through careful choice of design and materials. Economical features of the 251 engine include an oil-cooled aluminum piston equipped with a Ni-Resist insert at the top ring position to minimize groove wear and keep the ring properly supported on a flat surface; chromium-plated cylinder liners; cylinder heads equipped with four identical valve inserts secured in counter bores in the cylinder head; precision-type main and crankpin bearings with steel-backed thin walls; and crankshafts hardened either by the Tocco process or by nitriding. The engines have a torsional vibration damper of Alco design.

Railroads

Spectrographic Analysis of Diesel-Engine Lubricating Oils by the Rotating-Platform Method..60—RR-5... By J. C. Smith, General Electric Company, Erie, Pa. 1960 ASME-AIEE Railroad Conference paper (multilithographed; available to Feb. 1, 1961).

Spectrographic determination of wear products in used diesel-engine lubricating oil has gained wide acceptance with railroads in the United States as a means of determining diesel-engine wear without resort to costly, time-consuming inspection of parts.

Since its introduction more than ten years ago, a confusing array of analytical methods has been presented to the spectrographer. Experience over more than a year indicates that the rotating-platform method selected has attractive possibilities for railroad laboratories.

The procedure is described with the following apparatus used:

1 Spectrograph, Gaertner large quartz-prism instrument.

2 Source, NSL Uni-arc ignited by NSL University of Michigan type spark unit.

3 Densitometer, NSL nonrecording unit.

4 Developing equipment, NSL vertical plate processor.

5 Calculator, NSL drum-type unit.

The only special equipment required is a 10-rpm motor to drive the rotating platform electrode, a $^1/_8$-in-diam disk with a shallow annular depression in the top. This electrode is mounted on the motor shaft and rotated in a horizontal plane during excitation. The upper electrode is a $^1/_8$-in. flat-tipped rod centered above the annular ring.

The buffer, internal standard, excitation, exposure, and processing are included in the discussion.

Experience indicates that the rotating-platform method is superior in the following respects:

1 Accuracy, within plus or minus 10 per cent.

2 Sensitivity. This is better than one part per million of lead.

3 Speed. The total analysis time is 20 min per sample.

4 Cleanliness. Little smoke is produced during sample preparation and no oily residue remains on the arc-spark stand.

5 Versatility. The apparatus can be quickly installed or removed.

Automated Testing of Railway Freight Brake Control Valves..60—RR-4... By P. W. Brath and E. T. Skantar, Assoc. Mem. ASME, Westinghouse Air Brake Company, Wilmerding, Pa. 1960 ASME-AIEE Railroad Conference paper (multilithographed; available to Feb. 1, 1961).

Periodic testing of railway freight brake-control valves has been required, by mutual agreement among the railroads of the United States, so that established standards of performance will be maintained throughout the life of the equipment.

Under Association of American Railroads rules, both the service and emergency portions of the control valve must be removed from the car at least every four years for cleaning, repairs, and performance testing. The railroads handle about 900,000 valve portions each year, necessitating considerable investment in test facilities and trained personnel.

The purpose in automating the testing process is threefold. The first is to reduce the required level of operator skill; the second is to remove the operator from the decision-making process so that there is no tendency to shade results or to manipulate the tests in order that questionable valves will be passed; and the third is to reduce the total time and costs required for the testing process.

This paper describes the design and construction of a prototype automated test machine, the design objectives of which are to provide superior testing methods, to allow the use of unskilled personnel as operators, and reduce total testing costs.

The automatic test rack includes facilities for measuring variables, time, pressure, and flow using high and low range flowmeters and motorized tape reader in conjunction with a relay tree type of code translator, among other devices. Although the prototype rack has seen limited service, the authors are optimistic that all of the design objectives will be realized.

Study of the Defects That Originate and Develop in the Treads of Railroad Wheels During Service..60—RR-1... By J. M. Wandrisco and F. J. Dewez, Jr., United States Steel Corporation, Monroeville, Pa. 1960 ASME-AIEE Railroad Conference paper (multilithographed; available to Feb. 1, 1961).

The railroad wheel has always served as a brake drum as well as a means of locomotion. Because of this double function, it must not only withstand the dynamic stresses that result from rolling and from lateral thrust loads, but must also withstand the thermal effects that result from the friction created during braking.

Higher speeds and heavier loads that have resulted from dieselization have greatly increased the stress that railroad wheels must withstand. Development of wheels with improved resistance to these stresses is necessary, and materials are selected on the basis of the static and/or dynamic stresses that they are expected to withstand in service.

The approach to the problem of developing improved railroad wheels was first to gain a detailed knowledge of the mechanism and cause of the different tread defects that develop during service.

This paper describes the results of a comprehensive metallurgical investigation of numerous heavy-duty heat-treated wheels that contained defects which originated and developed during service —studies of the macrostructure, the microstructure, the mechanical properties, the residual stresses, and the fracture surfaces were made.

These studies were supplemented by laboratory tests on full-size wheels under simulated operating conditions on a large inertia dynamometer at United States Steel's Research Center at Monroeville, Pa.

This machine can subject wheels rang-

ing in size from 24 to 48-in. diam to conditions of speed, wheel loads, and braking pressures ranging from those that equal service conditions to those that exceed them by several hundred per cent.

At least two general types of defects were found to occur during service—defects caused by stresses developed by braking and defects caused by stresses imposed by rolling loads.

Defects caused by stresses developed as the result of braking are classified as (*a*) thermal checks, (*b*) sudden-type thermal cracks, and (*c*) fatigue-type thermal cracks.

Shelling is a defect that forms in the treads of railroad wheels as the result of rolling loads and is characterized by expulsion of pieces of metal from the tread surface.

Understanding Wheel-Rail Adhesion.. 60—RR-3... By G. M. Cabble, Jr., Mem. ASME, Westinghouse Air Brake Company, Wilmerding, Pa. 1960 ASME-AIEE Railroad Conference paper (multilithographed; available to Feb. 1, 1961).

This paper reviews the various facets of wheel-rail adhesion and advances the knowledge in one of these fields.

The terms of wheel-rail adhesion are defined. An extensive review of the problems associated with adhesion and the attempts to solve these problems is presented. The results of experiments conducted by the author on scale equipment show that creep is present as long as there is adhesion demand.

As the adhesion demand increases, the percentage creep increases until creep becomes slip and eventually slide. It is shown that true adhesion varies with velocity.

Suggestions are given for means of approaching true adhesion values on the railroad. The danger of wheel damage caused by high adhesion could offset the advantages.

Lateral Forces Between Wheels and Rails —An Experimental Investigation..60—RR-6... By P. E. Olson and Stig Johnsson, Swedish State Railroads, Stockholm, Sweden. 1960 ASME-AIEE Railroad Conference paper (multilithographed; available to Feb. 1, 1961).

Adoption of increased speeds in locomotives has consequently necessitated a more thorough study of forces between the wheels and the rails. Previous experimental tests for determining the lateral forces acting between the wheels and the rails were of limited value, since it had proved impossible to measure continuously the true lateral forces acting at the point of contact between the wheel and the rail.

With the continuous-measuring method described, the four disk wheels themselves of the front bogie of a Bo′-Bo′-express locomotive type Ra of the Swedish State Railways were used as gages for measuring the lateral forces.

Fundamental knowledge concerning these forces was obtained both from studies of the results from short test runs and from statistical assessments of the results from long sections of the Swedish railway network.

The new measuring method is based on a knowledge of the strain conditions established by means of extensive static measurements on the disk-type wheels with shrunk-on tires. On these disks there are certain points where the radial strains are very sensitive to lateral forces applied at the wheel periphery, but almost entirely insensitive to the vertical forces attacking any arbitrary point at the site of contact between the wheel and rail.

Since the tests are concerned only with a single locomotive, the results should not be generalized. The investigations have made it clear, however, by means of the individual diagrams of curve forces as well as the statistical evaluation of about 40 curve runs, that the lateral forces between the rails and the wheels of the leading axle are on the whole substantially greater than the resulting force on the permanent way.

This factor should be all the more noticed, since the utilized friction coefficient can assume such unexpectedly high values, as is shown from the measurements.

The pronounced transverse friction occurring contributes to the fact that the running of rolling stock is so very dependent on the pattern of the permanent way.

Many graphs illustrate the facts.

ASME TRANSACTIONS

The June, 1960, issues of the Transactions of the ASME—*Journal of Applied Mechanics* and *Journal of Basic Engineering* (available at $1.50 per copy to ASME Members; $3 to nonmembers)—contain the following:

Journal of APPLIED MECHANICS
Volume 82 • Series E • Number 2

TECHNICAL PAPERS

223 Note on the Assessment of Flow Disturbances at a Blunt Body Traveling at Supersonic Speeds Owing to Flow Disturbances in Free Stream, M. V. Morkovin. (60—APM-10)

230 Possible Similarity Solutions for Laminar Free Convection on Vertical Plates and Cylinders, Kwang-Tzu Yang. (59—A-86)

237 On the Annular Damper for a Freely Precessing Gyroscope, G. F. Carrier and J. W. Miles. (59—A-44)

241 Heat Transfer for Laminar Flow in Ducts With Arbitrary Time Variations in Wall Temperature, Robert Siegel. (59—APMW-21)

250 A Study of the Stability of Externally Pressurized Gas Bearings, Lazar Licht and Harold Elrod. (60—APM-5)

259 On the Theoretical Analysis of a Dynamic Thermocouple: 2—The Continuous Area Interface, W. F. Hughes and E. W. Gaylord. (60—APM-19)

263 Normal Modes of Nonlinear Dual-Mode Systems, R. M. Rosenberg. (59—A-93)

269 Classical Normal Modes in Damped Linear Dynamic Systems, T. K. Caughey. (59—A-62)

272 The Vibration Response of a Linear Undamped System Resting on a Nonlinear Spring, P. R. Paslay and M. E. Gurtin. (60—APM-6)

275 The Approximate Analysis of Certain Boundary-Value Problems, H. D. Conway. (59—A-80)

278 Stresses in a Slab Having a Spherical Cavity Under Circular Bending, Chih-Bing Ling and Chen-Peng Tsai. (59—A-64)

283 Elastic Equilibrium of a Plate With a Reinforced Ellipitical Hole, Eugene Levin. (59—A-45)

289 A Method of Solution for the Elastic Quarter-Plane, M. Hetényi. (59—A-92)

297 Thermal Stress in a Viscoelastic-Plastic Plate With Temperature-Dependent Yield Stress, H. G. Landau, J. H. Weiner, and E. E. Zwicky, Jr. (59—A-33)

303 Prediction of Creep Failure Time for Pressure Vessels, F. P. J. Rimrott, E. J. Mills, and Joseph Marin. (60—APM-7)

309 On the Plastic Behavior of Rotating Cylinders, F. P. J. Rimrott. (59—A-65)

316 On the Optimum Design of Shells, R. T. Shield. (59—A-47)

323 Yield Conditions for Rotationally Symmetric Shells Under Axisymmetric Loading, P. G. Hodge, Jr (59—A-129)

332 An Approximate Analysis of the Influence of Aerodynamic Heating and Initial Twist on the Torsional Stiffness of Thin Wings, L. S. Han. (60—APM-13)

335 Postbuckling Behavior of Rectangular Plates With Small Initial Curvature Loaded in Edge Compression—(continued), Noboru Yamaki. (59—APMW-22)

343 The Junction Problem of Solid-Slotted Cylindrical Shells, D. H. Cheng and N. A. Weil. (60—APM-2)

BRIEF NOTES

350 Method of Numerical Evaluation of a Large Determinant, F. R. E. Crossley and Ü. Germen. 352 On the Griffith-Irwin Theory, J. L. Sanders, Jr. 353 On the Flexure of Plastic Plates, S. Lerner and W. Prager. 355 Induced Velocities in Two-Dimensional Cascade Theory, J. Polasek. 356 Relation Between Stress Concentration and Boundary Displacement, J. S. Brock. 357 Bending of an Isotropic Triangular Plate, B. D. Aggarwala. 358 Simplified Analysis of a Thrust-Augmentation System, K. L. Bergman. 359 Stress Concentration in a Rotating Disk, Ta-Cheng Ku.

DISCUSSION

361 Discussion of previously published papers by M. K. Newman; M. V. Morkovin; P. G. Hodge, Jr., and R. Sankaranarayanan; Joseph Marin; R. R. Berlot; Norman Davids; T. Gillespie and A. W. Gunter; J. W. Daily, W. F. Riley, and A. J. Durelli; T. K. Caughey; H. H. Bleich and O. W. Dillon, Jr.; H. D. Conway; P. S. Theocaris; D. S. Johnson; R. P. Kanwal; Yi-Yuan Yu; C. W. Nelson; A. E. Bryson

377 **BOOK REVIEWS**

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251 The Fluids Engineering Laboratory at the University of Michigan, by G. V. Edmonson. (59—Hyd-16)

257 Flow Parameters in Hydrostatic Lubrication for Several Bearing Shapes, by S. Raynor and A. Charnes. (59—SA-61)

265 A General Method for Correlating Labyrinth-Seal Leak-Rate Data, by F. E. Heffner. (59—Lub-7)

276 Hydrostatic Gas Bearings, by J. H. Laub. (59—Lub-1)

287 Effect of Hardness, Surface Finish, and Grain Size on Rolling-Contact Fatigue Life of M-50 Bearing Steel, by R. A. Baughman. (59—Lub-11)

295 The Importance of Spinning Friction in Thrust-Carrying Ball Bearings, by G. S. Reichenbach. (59—Lub-9)

302 The Effect of Ball Bearing Steel Structure on Rolling Friction and Contact Plastic Deformation, by R. C. Drutowski and E. B. Mikus. (59—Lub-2)

309 A General Theory for Elastically Constrained Ball and Radial Roller Bearings Under Arbitrary Load and Speed Conditions, by A. B. Jones. (59—Lub-10)

321 A Sommerfeld Solution for Finite Bearings With Circumferential Grooves, by J. V. Fedor. (59—Lub-4)

327 Bearing Oil-Ring Performance, by D. C. Lemmon and E. R. Booser. (59—Lub-5)

335 Torque Produced by Misalignment of Hydrodynamic Gas-Lubricated Journal Bearings, by J. S. Ausman. (59—Lub-3)

342 Friction Characteristics of Sliding Surfaces Undergoing Subsurface Plastic Flow, by M. C. Shaw, A Ber, and P. A. Mamin.

347 Machining Characteristics of Leaded Steel, by F. L. Bagley, Jr., and R. Mennell.

360 A General Flow Graph Technique for the Solution of Multiloop Sampled Systems, by R. Ash, W. H. Kim, and G. M. Kranc. (59—NAC-1)

371 Control System Analysis and Design Via the "Second Method "of Lyapunov, Part I, by R. E. Kalman and J. E. Bertram. (59—NAC-2)

394 Control System Analysis and Design Via the "Second Method" of Lyapunov, Part II, by R. E. Kalman and J. E. Bertram. (59—NAC-3)

401 Relations Between the Notch Tensile Strength of Cylindrical and Prismatic Specimens of Titanium Alloys and Heat-Treated Steels, by G. Sachs, J. G. Sessler, R. F. Pray, and T. H. Yeh. (59—Met-2)

411 Nonmetallic Inclusions and Fracture Behavior of Steels, by S. Yukawa. (59—Met-10)

417 Fracture Mode Transition for a Crack Traversing a Plate, by G. R. Irwin.

426 Use of the Moire Effect to Measure Plastic Strains, by A. Vinckier and R. Dechaene. (59—Met-7)

435 A Generalization of Cumulative Damage, by R. M. Mains. (59—Met-1)

441 Effect of Relaxation on the Behavior of Materials Under Combined Alternating and Static Stress, by F. H. Vitovec. (59—Met-3)

447 Cyclic Operation of Pressure Piping With γ Heating, by K. R. Merckx. (59—Met-4)

453 Creep Rupture Tests for Design of High-Pressure Steam Equipment, by E. A. Davis. (59—Met-14)

462 Steady Creep of a Tube Under Combined Bending and Internal Pressure, by Iain Finnie. (59—Met-5)

465 Effect of Wall Thickness on Stress-Rupture Life of Tubular Specimens, by J. T. Tucker, Jr., E. E. Coulter, and L. F. Kooistra. (59—Met-11)

477 Design of Pressurized Cylinders for High-Temperature Applications, by J. F. Traexler. (59—Met-8)

482 The Response of a Pressure-Sensing System, by R. P. Benedict. (59—A-289)

489 Dynamics of Heat Exchangers and Their Models, by Herman Thal-Larsen. (59—A-117)

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COMMENTS ON PAPERS

Progress in Railway Mechanical Engineering 1958–1959

Comment by H. L. Decker[1]

In reviewing the report of Committee RR-6 Survey,[2] it makes one realize the tremendous amount of time that must have been devoted to the preparation of this report. The correlation of the various subjects covered, and the manner in which they have been briefed and put in such concise form, points to the time and effort which must have been expanded. My comments on the various subjects will be brief and will be in the nature of my opinion on the various developments.

With respect to locomotive development activities and with particular reference to diesel locomotives, the various experimental locomotives which are being used in limited numbers may or may not prove to be successful, and only lengthy service tests will determine whether or not they will prove to be acceptable types. Development in the United States is generally along the lines of increased hp, maintaining locomotive configuration presently in use.

Generally, the locomotives with increased hp are offered to the American railroads before sufficient road-service tests have been made and major design weaknesses associated with the increased hp overcome. This results in added expense to the railroads, which should be borne by the builder. In the future development of locomotives, we should like to see the various builders establish a committee among themselves and standardize on cab arrangements for the various classes of locomotives, giving due regard to requirements for adequate space, brake stand location, height of brake handles, proper vision, ventilation, and adequate seating space for a seat for a head-end brakeman. All controls for operating the locomotive should be within reach of the engineman and the locomotives should function in so dependable a manner that there would be no need for the engine crew to leave the operating cab at any time. Thus the full responsibility for any locomotive breakdown would rest with the maintenance forces.

The development of electric locomotives in this country, as well as in Europe, continues to be along the lines of ignitron rectifier-type, and it is anticipated that before too long dry-type rectifiers will replace the ignitron.

With respect to passenger cars, it is interesting to note that few trains are running today of the number of novel types that were introduced several years ago. The basic car still meeting the widest acceptance is the lightweight car having conventional trucks with conventional seating and floor height. Dome cars still prove to be popular on the western railroads and in scenic areas where there is sufficient overhead clearance to permit their use.

As pointed out in the Committee Report, emphasis is continuing on the use of special-purpose cars and accessories for hauling specific kinds of freight and coupled with this is the introduction of higher capacity draft gears of conventional as well as hydraulic designs; cushion underframes also have been developed with higher cushioning capacity, utilizing hydraulic methods of applying pressure to friction plates as cushioning means. Spring cushioning and load-restraining devices have been developed; but it is questionable, at this time, whether adequate means have been developed for properly restraining heavy loads, such as steel coils on pallets weighing as much as 20,000 lb on each pallet.

Floor strength of cars built today is not adequate to carry the loads imposed by the front wheels or lift trucks when transporting or loading the cars with the 20,000-lb steel coils. Wheel loads for these lift trucks when carrying the coils are calculated to be 43,000 to 50,000 lb on the front axle. On the Pennsylvania, we are utilizing four 4-in. zee stringers on each side of the center sill and supporting these stringers on an underframe consisting of all crossbearers, and the stringers in turn support $2^{3}/_{8}$-in. flooring covered by $^{1}/_{8}$-in. antiskid steel plate. To date this is the heaviest construction of which we have knowledge and which we believe to be adequate. However, service experience and time only will determine whether or not a stronger floor is necessary.

The large tank cars mentioned in the report are also causing some concern due to the high wheel loading which may reflect itself in rail damage due to excessive high shear stresses within the rail head.

Mention is also made of the trailer train cars which are being built in quantity by both the Pullman Company and ACF. These cars represent a departure from conventional car underframes in that the main strength members are made of welded fabrications to the exact strength requirements since no rolled sections are available for this purpose. By designing fabricated members to the requirements, a car of proper strength could be secured with the lightest weight, thus permitting maximum trailer loads without exceeding axle capacities.

The standardization of containers for highway freight and marine service continues to be a perplexing problem, and it is questionable whether standardized lifting devices, methods of handling, and so on, can be completely realized.

Author's Closure

The Committee on Survey wishes to thank Mr. Decker for his kind remarks.

[1] Mechanical engineer, CMO Div., Pennsylvania RR, Philadelphia, Pa. Mem. ASME.

[2] Report of Committee RR-6 Survey: Chairman, D. R. Meier; Members, R. M. Coultas, H. G. McClean, A. G. Dean, MECHANICAL ENGINEERING, February, 1960, vol. 82, pp. 66–75.

Mr. Decker's comments on a broad range of design and development problems confronting the railroad industry will be of interest to builders. The observations of operating people on the new ideas and new developments will aid in pointing the way toward future progress.

D. R. Meier.[3]

[3] Chairman, RR-6 Survey Committee, ASME, and Manager, Railroad Locomotive Engineering, Motor and General Division, General Electric Company, Erie, Pa. Mem. ASME.

BOOKS RECEIVED IN LIBRARY

Design and Performance of Gas Turbine Power Plants (High-Speed Aerodynamics and Jet Propulsion, Vol. XI.)

Edited by W. R. Hawthorne and W. T. Olson. 1960, Princeton University Press, Princeton, N. J. 563 p., 6 1/2 × 9 1/2 in., bound. $15. This volume is designed to provide a basic source of present-day knowledge in the field of aircraft gas turbines. Combustion-chamber design includes the basic requirements and processes of the system, experimental techniques, fuel injection, flame stabilization, mixing processes, fuels to be used, and developmental considerations. The mechanics of materials and flutter problems are covered in the following section, and finally the various performance criteria which are used in the design of the engines are considered.

Grosse Dampfkraftwerke, Planung, Ausfuhrung und Bau, Band 1: Kraftwerksatlas

Edited by Karl Schröder. 1959, Springer-Verlag, Berlin, Germany. 1073 p., 8 × 11 in., bound. 192 DM. This first volume of a comprehensive work on large steam-power stations is a "Power Station Atlas" containing concise, illustrated descriptions of 98 power stations all over the world. There are large chapters on the Eddystone powerplant and the TVA plants, as well as on power stations in Germany, Italy, and Argentina. Part 2, when published, will deal systematically with the design and construction of power stations in general.

Handbuch der Mechanisierung der Kohlengewinnung

Edited by Heins Kundel. 1959, Verlag Glückauf G.m.b.H., Essen, Germany. 135 p., 6 × 8 1/4 in., bound. 17 DM. This German handbook dealing with the mechanization of coal digging is a valuable guide to equipment and machinery for this purpose. In addition to photographs and sketches of the machines, there are descriptions and pictures of the various phases of mining processes. Data on the economy of mechanization and on operational methods also are included. The book contains a bibliography, mainly to German references. A list of manufacturers is appended.

Industrial Electronics and Control

By Royce Gerald Kleoffler. Second Edition. 1960, John Wiley & Sons, Inc., New York, N. Y. 540 p., 6 × 9 1/2 in., bound. $10. A practical survey for the nonspecialist, beginning with the theory of solid-state conduction and leading to the theory of rectification and amplification via the semiconductor. Current practice in such application as resistance welding and high-frequency heating, and recent developments such as solid-state thyratrons, cryotrons, and cold cathode vacuum tubes are covered, and there is new material on semiconductors, magnetic amplifiers, computers, electronic measurements, and servos.

Industrial Instrument Servicing Handbook

By Grady C. Carroll. 1960, McGraw-Hill Book Company, Inc., New York, N. Y. Various pagings, 6 1/2 × 9 1/2 in., bound. $16. The servicing and maintenance of over 50 types of modern industrial process measuring and control instruments are detailed in this work, together with the principles of operation and complete calibration instructions for each. Instruments for gas analysis, for measuring pressure, fluid velocity, liquid level, temperature, viscosity, and specific gravity, and for the measurement and control of mechanical speeds are included. There is also a detailed chapter on the organization and staffing of an instrument maintenance department, and a precise tabulation of thermocouple temperature—millivolt equivalents.

Industrial Thermal Insulation

By Allen C. Wilson. 1959, McGraw-Hill Book Company, Inc., New York, N. Y. 295 p., 6 1/4 × 9 1/4 in., bound. $9. Insulation for piping, equipment, and structures used by American industry in the temperature ranges between the boiling point of water and 2000 F, and below the freezing point of water has been the object of recent research. This book deals specifically with heat transfer, calculation and interpretation of heat losses, and methods of application within these ranges. A large part of the book pertains to specifications for the insulation of hot piping and equipment; insulation of hot surfaces and application methods and specifications for low-temperature insulation are outlined. An appendix contains abbreviations, definitions, and terms, with tables and charts.

Manuel de Base de l'Ingenieur. (Tome 1: Mathematiques—Mecanique)

Edited by S. H:son Tideström. 1959, Dunod, Paris, France. 648 p., 6 × 9 in., paper. 5800 Fr. This French translation of the general section of the Norwegian "Ingenjörshanboken" presents a collection of the major theories and methods employed by the engineer. Each of the seven sections presents concise, encyclopedic articles on specific concepts by experts. A general introduction to the various systems and units of measurement precedes the major sections on mathematics, statics and dynamics, strength of materials, fluid dynamics, geometric measurements, mechanical measurements, and conversion tables.

Nuclear Radiation Engineering

By F. W. Hutchinson. 1960, The Ronald Press Company, New York, N. Y. 155 p., 6 1/4 × 9 1/4 in., bound. $6. The fundamentals of atomic structure, the source of nuclear energy, and the principles of radioactivity are presented for the growing number of administrators who must be technically informed in their dealings with nuclear scientists and engineers. In serving as a primer for those who must speak the language and understand the problems of atomic science, it explains the atomic and nuclear causes of radioactivity, the kinds of radioactivity, the energy release associated with the process of radioactive disintegration. These areas, rather than reactor engineering, are of immediate concern to executives and supervisors of nuclear engineers. A dictionary of atomic and nuclear terms and phrases is included.

Office Building and Office Layout Planning

By Kenneth H. Ripnen. 1960, McGraw-Hill Book Company, Inc., New York, N. Y. 182 p., 7 1/2 × 10 1/4 in., bound. $10. Here is a comprehensive manual on the planning and maintenance of office buildings. The first half of the book deals with the planning of offices and office-space administration. Specific, practical help in working out space requirements and maintaining proper space standards is given. The remaining part covers office building and construction, and the factors that must be considered by management in its choice of new office space.

Oil Property Evaluation

By John M. Campbell. 1959, Prentice-Hall, Inc., Englewood Cliffs, N. J. 523 p., 6 1/4 × 9 1/4 in., bound. $12. Considers factors playing a part in the establishment of value of oil properties, such as raw materials, cash recovery, the six-tenths rule, reserves, and Hoskold's method. The author outlines the general economics of the petroleum industry, with an analysis of demand trends and taxation structure; he then covers the methods for calculation of reserves and prediction of future performance, discussing the tools available; and thirdly, he explains the preparation of the evaluation, the cost estimates, and the profit analysis.

An Outline of United States Patent Law

By Richard E. Brink and others. 1959, Interscience Publishers, Inc., New York, N. Y. 280 p., 6 × 9 1/4 in., bound. $7.50. This book combines in logical sequence the material related to obtaining and enforcing a patent which is included in the Rules of Practice of the United States Patent Office in Patent Cases, Title 35 of the United States Code, and the Manual of Patent Examining Procedure. In outline form the procedures of preparing a patent application, filing it, the internal and external reviews of decision, the course of interference, and the rights granted under a patent are presented. In separate appendixes, Title 35 and the Rules of Practice are included in their entirety with a list of citations and a note on foreign practice and rights.

The Petroleum Handbook

Compiled by members of the staff of companies of the Royal Dutch Shell Group. Fourth Edition. 1959, Shell International Petroleum Company Limited, London, England. 678 p., 7 × 9 1/2 in., bound. No price given. This new edition of the handbook includes the changes in the industry through expansion of chemical interests and of research carried on in various parts of the world. It is a basic guide to the production, manufacture, storage, transportation, distribution, and application of petroleum products and chemicals. The manufacture of oil products covers distillation, cracking, absorption, reforming, and refining; applications include aviation, automotive, marine, industrial, and locomotive uses; petroleum wax, and bitumen. Petroleum chemicals fabrication and applications deal with solvents, detergents, synthetic resins and fibers, industrial and agricultural chemical derivations.

Physical Metallurgy of Stress Corrosion Fracture (Metallurgical Society Conferences, Vol. 4)

Edited by Thor N. Rhodin. 1959, Interscience Publishers, New York, N. Y. 394 p., $6^1/_4 \times 9^1/_4$ in., bound. $13. The first half of this volume outlines the principles relating the three basic factors of stress, fracture, and chemical reactivity; the second half is addressed directly toward clarification of the mechanisms of stress corrosion cracking in terms of specific environment and materials. Especially considered throughout the book are the relationship between stress and chemical reactivity, the concept of embrittlement by localized corrosion, interactions between the initiation and propagation stages of cracking and the influence of crystallography, the effect of specific alloy compositions and chemical movements on failure mechanisms, and the application of dislocation movement to crack growth. The papers constitute a symposium sponsored by various divisions of the American Institute of Mining, Metallurgical and Petroleum Engineers, in co-operation with other societies.

Power Station Engineering and Economy

By Bernhardt G. A. Skrotzki and William A. Vopat. 1960, McGraw-Hill Book Company, Inc., New York, N. Y. 751 p., $6^1/_4 \times 9^1/_4$ in., bound. $12.50. This retitled second edition of the authors' "Applied Energy Conversion" is virtually a new book, although again stressing the study of the powerplant as an integrated engineering system. Both thermal and water power stations are covered, with emphasis on the steam plant. Among the recent advances covered are: Nuclear energy in power production, gas turbine plants, modern systems of water conditioning, thermoelectric generators, solar energy, and fuel cells. Since the system concept is considered basic, system problems on station energy balances are plentiful. Other features include a complete economy study of powerplants, an extensive discussion of supercritical steam cycles and large capacity steam turbines, and extensive problem work on heat balance.

Proceedings of the Second Japan Congress on Testing Materials

Published 1959 by the Japan Society for Testing Materials, Kyoto, Japan. Various pagings, $8^1/_2 \times 11$ in., paper. No price given. This volume contains English editions of 67 of the papers presented at this 1958 Congress by Japanese scientists and engineers. Section 1 contains papers on metallic materials, including steel, cast iron, titanium, zirconium, and some alloys. Section 2 deals with such nonmetallic materials as wood, concrete, clay, glass, plastics, rubber, and synthetic fibers. Section 3 looks at testing methods and apparatus, including an ultrasonic thickness tester, resistance wire strain gages, and vibrographs. An appendix gives catalog information on Japanese industry.

Quality Requirements of Super-Duty Steels (Metallurgical Society Conferences, Vol. 3)

Edited by R. W. Lindsay. 1959, Interscience Publishers, New York, N. Y. 309 p., $6^1/_4 \times 9^1/_4$ in., bound. $8.50. These steels are those which have to resist unusual or severe environments (aircraft engines, airframe structures, and reactors), or which have chemical, mechanical, and physical properties that are superior to those of conventional carbon steels (some of the heavy-duty ones being stainless steels, hot-work die steels, high-strength alloy and carbon steels, and steels for meeting high-temperature or low-temperature service). The 15 papers cover the areas of the relationship of uses and required properties; the relationship between composition, structure, and properties; air melting practices; and special steelmaking practices. The papers constitute the proceedings of a symposium sponsored by various divisions of the American Institute of Mining, Metallurgical and Petroleum Engineers.

Reactive Metals (Metallurgical Society Conference, Vol. 2)

Edited by W. R. Clough. 1959, Interscience Publishers, New York, N. Y. 610 p., $6^1/_4 \times 9^1/_4$ in., bound. $15. Papers in this volume cover nuclear properties and applications, interstitial effects, temperature effects, phase relationships, melting and refining methods, powder techniques, and the processing and fabrication of reactive metals. Some articles deal with procedures applicable to several metals, such as those on consumable electrode and electron beam melting, casting, slip casting, powder metallurgy, and the microgravimetric sorption method; some apply only to one metal and its individual properties. A wide range of types of metals is covered. The papers constitute the Proceedings of the Third Annual Conference sponsored by Niagara Frontier Section in co-operation with the Metallurgical Society of the AIME.

Rubber to Metal Bonding

By S. Buchan. 1959, Palmeston Publishing Company, New York, N. Y. 300 p., $5^3/_4 \times 9$ in., bound. $7.50. A comprehensive treatment of current technology in the field, particularly as developed through applications in automobiles, airplanes, vibration dampers, etc. The brass-plating method occupies about half the book both because it is in common usage in Britain and on the Continent and because it is a standard against which newer processes are measured and judged. The various types of bonding cements discussed have been classified on the composition of their basic ingredients. The final chapter emphasizes the importance of design for bonded units.

Selected Topics on Ballistics

Edited by Wilbur C. Nelson. Published 1959, as Agardograph No. 32, by Pergamon Press, Inc., New York, N. Y. 280 p., $6^1/_4 \times 10$ in., bound. $9. Included in these papers presented at the Centenary Colloquium in West Germany in honor of Carl Cranz, is a review of his works and a brief biographical sketch. The remaining papers, by British, American, French, and German scientists, are practical and theoretical investigations in the field of ballistics, discussing such forms of projectiles as rockets, meteorites, satellites, and guided missiles. Included also are historical surveys of British and American ballistics research, the ballistics and launching of the American satellite Explorer I, stability and controllability aspects of guided missiles, and aeroballistics and underwater ballistics.

Solutions to Professional Engineer Examinations, New York State (Basic Engineering Sciences, Part 2)

By William Glendinning. Published by the author, 5123 Bell Blvd., Bayside, N. Y. 145 p., $8^1/_2 \times 11$ in., paper. $3.50. Here are detailed solutions and answers to problems in basic mechanics and machine design, fluid mechanics and hydraulic machinery, thermodynamics and heat transfer, and electrical principles and equipment. The problems included were selected from past examinations in Professional Engineering, Part 2, of the New York State Board of Examiners, over the past 14 years. The publication is the outgrowth of teaching review courses conducted over the past 15 years by the ASME and AIEE in the Metropolitan area to assist engineers preparing for PE examinations.

Structure and Properties of Thin Films (Proceedings of an International Conference Held at Bolton Landing, N. Y., Sept. 9–11, 1959)

Edited by C. A. Neugebauer and others. 1959, John Wiley & Sons, Inc., New York, N. Y. 561 p., $8^3/_4 \times 11^1/_2$ in., bound. $15. Review papers in this volume contribute to the areas of preparation, growth, and structure of thin films, and their mechanical, electrical, optical, and magnetic properties. A review of processes occurring at the metal surface is also given. Research papers present basic problems in physics and chemistry concentrating on ferromagnetism in small specimens, the nature of chemisorption, and the effects of small dimensions on various properties. The use of thin films to obtain information about the bulk properties of matter, the investigation of properties of thin films which vary from properties of the same material in bulk form, the growth and characterization of thin films, surface chemistry, and the theory of surfaces are the fields covered.

Textile Engineering Processes

Edited by A. H. Nissan. 1959, Interscience Publishers, Inc., New York, N. Y. 366 p., $5^1/_2 \times 9$ in., bound. $9.25. Separate papers by experts in each particular topic provide a systematic examination of British textile engineering, from the properties of natural and synthetic fibers, yarns, and fabrics, to air properties, humidity, and control. Examination of preparatory processes such as opening, drawing, spinning, winding, beaming, and sizing follows the raw materials section and precedes discussion of manufacturing techniques such as weaving, knitting, water extraction, drying and conditioning, and dyeing and printing. The final chapter describes and explains automatic control of textile plant machinery.

Theory and Application of Mechanical Engineering Measurements

By Mark B. Moore. 1960, D. Van Nostrand Company, Inc., Princeton, N. J. 296 p., $6^1/_2 \times 9^1/_2$ in., bound. $6.75. Advocating creative thinking in the laboratory, this manual subordinates standard techniques and emphasizes experimental investigations in problem solving. Beginning with the philosophy, processes, and error sources of measurement, the author then examines mechanical measurements and the instruments used, considering both single and simultaneous-reading procedures. The creative approach then is expounded as originality and careful analysis of

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the problem followed by the organization, performance, and effective reporting of experimental investigations. Basic mechanical engineering apparatus, and measurement of radiation intensity form the final chapters, and useful conversion and thermodynamic tables are included as appendixes.

Theory of Mechanical Vibration

By Kin N. Tong. 1960, John Wiley & Sons, Inc., New York, N. Y. 348 p., 6 × 9½ in., bound. $9.75. This treatment of the theory of linear mechanical vibrations uses analytic principles to demonstrate the unity and coherence of the theory and its connection with other engineering sciences. Four sections cover systems with a single degree of freedom, systems with a multidegree freedom system and the concept of vibration modes, an extension of these results through matrix algebra and generalized co-ordinates, and the vibration of continuous media. Each part presents first the theory and principles, and a second section contains methods and applications. The principle of superposition, eigenvalue problem in matrix, differential and integral equations, and energy methods receive special consideration.

ASTM Standards on Methods of Atmospheric Sampling and Analysis

Published 1959 by the American Society for Testing Materials, Philadelphia, Pa. 104 p., 6¼ × 9¼ in., bound. $2.25. This special compilation includes a test for odor in industrial water and industrial waste water, as well as definitions, practices, and tests of the atmosphere, gases, and vapors.

ASTM Standards on Metallic-Coated Iron and Steel Products

Published 1959 by the American Society for Testing Materials, Philadelphia, Pa. 168 p., 6¼ × 9¼ in., bound. $3.50. All but five of the 34 standards are new or revised. The metals represented in the coatings are zinc, aluminum, and terne-alloy.

Advanced Aero Engine Testing

Published for the Advisory Group for Aeronautical Research and Development by Pergamon Press, New York, N. Y. 298 p., 6¼ × 10 in., bound. $9. The specialized facilities for testing air-breathing engines, the testing of the components of these engines, and the problems in this type of testing are the subjects of papers in this volume. Conventional wind-tunnel experimental techniques are different from these procedures although the facilities are similar. The two techniques are compared, and in-flight measurements are checked with results obtained in ground-testing facilities. In the next section, compressors and turbines, combustion scaling, the measurement of the temperature of turbine blading, and the generalization of component test results are covered. Problems in the final testing and first flight of a supersonic engine comprise the final chapter.

The Aerodynamics of Powered Flight

By Robert L. Carroll. 1960, John Wiley & Sons, Inc., New York, N. Y. 275 p., 6 × 9¼ in., bound. $8.50. Using analysis of rocket thrust as a logical means of introduction to aerodynamics, the author provides a foundation in fluid flow and airfoil theory by developing the concept of lift and drag in incompressible flow, compressibility effects in subsonic flow, shock-wave formation, and supersonic flight. He introduces the fundamentals of propulsion and propeller analysis, stability, performance, and maneuvering flight, design and testing, and control. The mathematical approach is simple without being too elementary, and problems are given at the end of each chapter.

Aircraft and Missile Design and Maintenance Handbook

By Charles A. Overbey. 1960, The Macmillan Company, New York, N. Y. 369 p., 6¼ × 9¼ in., bound. $9.75. This work is applicable for piston-driven and jet planes, helicopters, and guided missiles. Technical data on electrical and plumbing systems, materials of construction, hardware, color codes, and on processes such as metal spraying, anodizing, plating, and welding are presented here, along with numerous tables and figures illustrating standard methods of equipment installation. The text explains the methods and gives guidance in the handling of materials and tools.

Analytical Chemistry of Titanium Metals and Compounds

By Maurice Codell. 1959, Interscience Publishers, Inc., 250 Fifth Avenue, New York, N. Y. 378 p., 6¼ × 9¼ in., bound. $12. The aim of this work is to provide analytical chemists with the information necessary for analysis of titanium-containing material. Published and report material has been gathered from authorities in the analytical chemistry field, and any procedures or principles not fully substantiated have been tested. A general section on the chemistry, sampling and separation procedures, and emission spectograph and vacuum line methods, as applied with titanium, is followed by detailed sections on the determination of metallic (aluminum, tungsten, copper, etc.) and nonmetallic (boron, chlorine, nitrogen, etc.) elements in titanium and its alloys. The final section contains analyses of titanium-base materials such as titanium tetrachloride, concentrates, and ores.

CRC Diesel Engine Rating Manual

Published 1959 by the Coordinating Research Council, Inc., New York, N. Y. 72 p., 9½ × 11½ in., bound. $50. Incorporating a standardized system for rating diesel engines for deposits and wear, the purpose of this manual is to define conditions observed, reserving evaluation of these conditions to the individual laboratory. General considerations such as definitions of terms, recording of test conditions, and gradation of diesel engine conditions are contained in the first section. The second section presents detailed rating techniques for each element of diesel and some other engines. The manual is profusely illustrated.

Cathodic Protection

By John H. Morgan. 1960, The Macmillan Company, New York, N. Y. 325 p., 6¼ × 10 in., bound. $12. The technique of the electric method of corrosion prevention, rather than the electrochemistry of the interface, is the subject of this English textbook on cathodic protection. The first part of the book is devoted to the methods and the factors involved in this method of prevention; the second part considers the procedures in achieving protection in a variety of structures, such as buried pipes and tanks, structures in sea water, structures containing interference corrosion. Instruments for cathodic protection and the economics of this method are dealt with in the last chapters of the book.

Chemical Analysis, Vol. X: The Chemical Analysis of Air Pollutants

By Morris B. Jacobs. 1960, Interscience Publishers, Inc., New York, N. Y. 430 p., 6¼ × 9¼ in., bound. $13.50. Methods given here for the determination of the kind of air contaminants include general methods for sampling and for determination of volume, quantity, and velocity of air and gas; analysis of settled and of suspended particulate matter; and analysis of gaseous and vapor contaminants. Methods also are given for determination of the amount of pollution emitted by any given source, such as chimneys, motor vehicles, and incinerators, and evaluation of effectiveness of abatement devices. The final chapter examines air-pollution-monitoring devices such as sequence absorbers, multiple gas samplers, and autometers.

Compression and Transfer Moulding of Plastics

By J. Butler. 1959, Interscience Publishers, Inc., New York, N. Y. 230 p., 5¾ × 9 in., bound. $5.75. A Plastics Institute monograph intended for students of mold design, designers, and mold shop executives. The section on compression molding gives historical background and development, discusses types such as cavity, three-plate, and split displacement molds, pretreating, molding with powders, and the effect of materials on mold design. Transfer molding is discussed in the same pattern, while covering also specific transfer problems as feed systems and size, gate areas and position, clamping pressures, and split dies.

Creativeness for Engineers

By Donald Stuart Pearson. Third Edition. Published 1960 by author, University Park, Pa. 150 p., 5¾ × 8¾ in., bound. $3.95. The author, a professor of electrical engineering, presents a philosophy and practice for scientific thinking. The history of creative thinking is outlined, and a general résumé of the qualities and qualifications for creativity is given. The second section considers problem solving for engineers, showing how to recognize, define, evaluate, and analyze a problem, and interpret its solution. Examples used include heating, vibration, and electromechanical analyses, and synthesis of equations, a spring-mass system, and a circuit breaker.

Cybernetics and Management

By Stafford Beer. 1959, John Wiley & Sons, Inc., New York, N. Y. 214 p., 5½ × 8¾ in., bound. $4.50. This account of cybernetics written with management specifically in mind, presents the basic principles of the nature of control and explicates the main concepts with a minimum of mathematics and scientific detail. This book brings together theories on control from logic, biophysics, and analog theory in such a way that the information from these diversified fields can be a scientific tool for understanding and organizing systems and machines useful in the handling of men and situations.

Elements of Ion Exchange

By Robert Kunin. 1960, Reinhold Publishing Corporation, New York, N. Y. 164 p., 5¼ × 7¾ in., bound. $5.75. Specifically written for those with little or no theoretical background in physics, this small book provides a basic view of ion-exchange technology for executives, operating personnel, chemists, engineers, agronomists, and nuclear researchers. Most of the book is devoted to the fundamental theory of ion exchange—the nature of the materials involved, their structure, the techniques of testing and evaluation, and both general and specific principles of their application. Ion-exchange engineering and design practice is also presented in a brief chapter.

Current Engineering Events, News, and Comment

E. S. NEWMAN
News Editor

THE ROUNDUP

World Still Looks to U. S. A. for Technical Leadership, Says R. C. Allen at University of Wisconsin

ROBERT C. ALLEN, Fellow ASME, and leading Wisconsin engineering industrialist, told an audience of some 400 engineers and industrialists on the University of Wisconsin campus recently that "the rest of the world still looks on us in the U. S. A. as the torchbearers along the road of technical progress."

Mr. Allen, director of engineering of the industries group of Allis-Chalmers Manufacturing Company, Milwaukee, Wis., one of Wisconsin's largest heavy industries, told a UW Engineers' Day dinner audience that "even engineering representatives of the Soviet Union who have visited my company seem to reflect that feeling."

He was one of six leading engineers and industrialists who were presented with distinguished service citations by the University at the dinner held in Great Hall of Wisconsin's Memorial Union. (See "People," MECHANICAL ENGINEERING, June, 1960, page 123.)

Speaking on the subject, "Energy for the Future," Mr. Allen used the term "energy source unit" as representing thermal energy equal to that which would be released by the "combustion of 38 billion tons of good powerhouse coal."

"U. S. Bureau of Mines statistics show that we in the U. S. are endowed with natural fossil-fuel resources equal to about 70 energy source units, or equivalent to 70 times 38 billion tons of coal," Allen said. "Our present rate of consumption is in the neighborhood of 1/25th of an energy source unit per year.

"Simple arithmetic would seem to indicate 1750 years of fossil-fuel supply," he explained, "so why worry about nuclear fission, nuclear fusion, fuel cells, or magnetohydrodyanamics, to say nothing of the technological race with the people with whom we are daily struggling for coexistence in the Soviet Union?"

Referring to energy consumption on a world-wide basis, Mr. Allen pointed out that the present world rate seems to be about one eighth of an energy source unit per year.

"But the tremendous number of people who live in the undeveloped countries and who are slowly awakening to the possibilities of better ways of life, brought about largely by greatly improved methods of communication, can be expected to increase their rates of energy consumption during the next century much faster than we in the U. S.," he said.

"Instead of the 2 per cent annual increase in energy use predicted for the U. S., the boiling down of an imposing array of data for the world picture points to a possible 3.5 per cent," he said. "These considerations point to a time less than 100 years hence when the world supplies of fossil fuels will not meet the explosively increased demands resulting from increased population and the demands of various peoples for betterments in ways of life."

Against this picture of depletion of world supplies of fossil fuels as energy sources, Mr. Allen described eight sources of future power as follows, with his comment on each:

1 Solar Energy which comes to us in almost limitless quantities—"It is my feeling that solar energy deserves continued study and that it should be employed where warranted by local economics."

2 Wind Power continues to be of interest in the world energy picture—but "does not appear to be an important contributor to large-scale power generation in the foreseeable future."

3 Nuclear-Fuel Energy such as large powerplants which depend on the splitting of atoms of the heavy element uranium for their source of energy—"If we take the over-all data that have been estimated for the world picture relative to nuclear-fuel resources, there appears a total figure of 1700 energy source units, which is approximately eight times the energy estimated for the total of the fossil fuels. If we now attempt to estimate the probable economically recoverable amount of uranium and thorium, the answer arrived at by various investigators is that the energy content of the economically recoverable uranium and thorium is around 20 times the energy in the economically recoverable fossil fuels. It therefore seems evident that we have developed a source of energy that will carry us far beyond the time when our fossil-fuel resources have become too expensive to mine."

4 Electric Motorcar interest has been revived in recent years, with the search for new electrical storage systems being studied and actively developed—"There seems to be good reason to conclude that two decades, or certainly not more than three, will witness serious increases in cost of the fuels derived from petroleum which are used in our motorcars. The economics of private automotive transportation, so necessary to our American way of life, may become a critical issue sooner than some of the other phases of the energy problem here reviewed."

5 Thermonuclear Fusion process that has been envisioned as a most bountiful future source of power—"Some indications point toward a possible minimum economic size of a thermonuclear fusion reactor of two million to five million kilowatts. Such plants might conceivably be employed for the electrolysis of water to provide the component gases for fuel cells which may be employed in future automotive transportation."

6 Thermoelectric Power Generation, with the advantages that it is noiseless, the generating components have no moving parts, and at least theoretically

they should last indefinitely—"It is believed that the future will see an increased use of thermoelectric components. One development group working in this field predicts that the year 1970 may see 100,000-kw thermoelectric power generating units. I believe this to be entirely possible."

7 Thermionic Power Generation in which it has been demonstrated that two plates of selected materials, placed close together in parallel alignment, will develop a potential difference, and an electric current will flow in an external circuit, if one is heated to a sufficient degree—"Scientists working in this field express optimism with regard to the possible future application of this concept to electric power generation."

8 Magnetohydrodynamic Concept which refers to the motion of electrically conducting fluids in the presence of a magnetic field—"Present conventional powerplants with the most advanced steam conditions for which reliable equipment can be built and operated are just about reaching the 40 per cent efficiency level for economic service. The magnetohydrodynamic concept promises a jump from 40 to at least 60 per cent, which would be a welcome improvement in efficiency and result in a substantial saving of our fossil-fuel reserves."

Air-Safety Research Appraised by Cornell-Guggenheim Aviation Safety Center

"Eight important areas" in aviation safety are not now being adequately studied and call for "further research, development, or special monitoring" to promote greater flying safety, according to the tenth annual survey of air-safety research in the United States and Western Europe, recently released by the Cornell-Guggenheim Aviation Safety Center.

The Center reported that, although substantial progress has been made in safety research since 1958, areas such as altimetry, collision avoidance, crash fire protection, occupant protection, weather forecasting, subsonic research facilities, private flying, and human factors are still receiving insufficient attention.

The 1960 survey contains a listing of over 370 research projects being conducted in the United States, Canada, and Western Europe, including some 125 established during 1959. The European listings were obtained from the Center's representative there and include projects in such areas as braking on snow and ice, pilot fatigue, and statistical concepts of safety.

Reviewing the safety picture last year, the Center reported that approximately 70,000 private and business aircraft suffered 4800 accidents resulting in 778 deaths. The survey adds, however, the business flying portion of this activity was conducted at a rate much better than this total and one which is constantly improving. In addition, 257 lives were lost in 11 commercial airline accidents. The passenger fatality rate on the U. S. domestic and international airlines was 0.7 per 100,000,000 passenger miles flown.

"Since the implementation of the Federal Aviation Act of 1958," the survey stated, "many of the problem areas reported last year as requiring further research are receiving high priority and financial support." However, it continued, the following areas require further research and development:

1 Altimetry. A continued effort, "and a strong one," the survey states, should be made to improve altimetry to the point where accuracy is unquestioned. Deficiencies must be overcome through international standards for calibrating altimeters, the installation of altimeter correction cards, frequent checking of instruments, tubing, and connections.

2 Collision Avoidance. The Federal Aviation Agency should continue its interest and financial support for research and development of an anticollision device or warning indicator. Since only eight per cent of collisions occur in head-on flying, the report said, "the Center hopes the industry will not wait for the perfect device" if another, which can be more immediately available, can be used to alleviate the other 92 per cent collision potential.

3 Crash Fire Protection. The need is urgent, according to the survey, for the application of already developed principles to aircraft operation. "The Center strongly urges Congressional support" for Federal Aviation Agency programs in this direction.

4 Occupant Protection. Survivability depends on built-in protection, since analysis shows 60 per cent of airline accidents occur away from the airport. "There is a great need for the dynamic testing of seats and aircraft structure to provide a maximum of protection with a minimum of weight," the survey stated.

5 Weather Forecasting. "It is hard to conceive of a single area of research and development," the survey noted, "which would be of more immediate benefit to aviation than improvement in the speed and accuracy of weather forecasting. The Federal Aviation Agency, the military, and the Weather Bureau have combined on several excellent programs for promoting this knowledge, but Congress has delayed its approval of financial support for these proposals."

6 Subsonic Research Facilities. Transfer of trained personnel and research facilities from the subsonic field to space problems, the survey observed, may result in a marked reduction of safety development in the areas where they are most needed from the standpoint of public use and safety.

7 Private Flying. "The FAA has taken steps," the survey points out, "to require newly trained pilots to have a minimum ability to control their aircraft when caught inadvertently under instrument conditions. This one step should reduce fatal accidents in private flying by some 25 or 30 per cent. There still remains the problem of training 300,000 already certified pilots in this art. . . This, perhaps, is a problem of education and enforcement, but the Center believes it should be studied."

8 Human Factors—Sociological Problems. The survey declared that consideration of human factors in the design and operation of aircraft is now well recognized as a vital contribution to aircraft safety, but pointed out there are gaps between what is known and what is applied. In this regard, the survey recommended that attention be given to the matters of personnel and industrial relations.

The Cornell-Guggenheim Aviation Safety Center, an independent organization operating under a grant from the Daniel and Florence Guggenheim Foundation, was established in 1950 to promote improvement of aviation safety through research, education, and training, as well as the dissemination of safety studies to the industry and air-safety information to the general public.

Harry F. Guggenheim is chairman of its governing body. Dr. Theodore P. Wright, vice-president for Research, Cornell University, is chairman of the executive committee. Jerome Lederer, Mem. ASME, is director of the Center. The Survey of Research Projects was prepared under the direction of Ruland M. Woodham, associate director of the Center.

"People-to-People" Program Needs Technical Journals

"People-to-People" is a program of international friendship between Americans and the people of other lands. The program was started in 1956 and has had the constant support of President Eisenhower.

The Program. Scientists and Engineers make up one of the categories which support this massive program of communication. Other fields of international exchange involved in the program include health, farm, business, cultural, labor, religious, sports, military, and service organizations. More than 1000 men and women are members of 33 committees functioning in a continuous effort to establish international friendship through this program.

Completely nonpartisan and outside governmental control, the People-to-People program depends upon the Americans' willingness to give time and effort to the cause of international friendship and peace.

Individual Contribution. The individual's contribution may take the form of letter writing, sharing books and magazines with people in foreign countries, promoting an affiliation between hometown and some foreign community, inviting foreign visitors to enjoy the hospitality of an American home, or working through business, civic, social, or cultural organizations that are endeavoring to promote international friendship and understanding.

Periodicals for Universities. Insuring that universities get periodicals that suit their individual needs is the most important element in the work of the program's Scientists and Engineers Committee. R. B. Lea, Mem. ASME, a former vice-president of Sperry Gyroscope and co-ordinator of exports for the Sperry Corporation, who retired in 1956, is vice-chairman of the Scientists and Engineers Committee.

Journals published by the mechanical, civil, electrical, mining, and petroleum engineering societies are the publications needed in the largest quantities by the Middle East engineer who is concerned with harnessing natural resources, building roads, hospitals, and schools, and getting industry started.

How It Is Done. The machinery of collection and shipment works in this way: Individuals in several large engineering organizations including Anaconda, American Cyanamid, Sperry Rand, and others donate their personal copies of journals. Publishers contribute their unsold copies, and technical societies supply their surplus preprints of papers. At a Long Island warehouse where space has been donated by Sperry Rand, publications are sorted by volunteers, among whom are the retired scientists and engineers. They prepare shipments from lists sent by the universities. The complex paperwork for customs clearance also is donated by Sperry Rand. Cartons are transported free to the Middle East by private shipping companies or Navy ships. Mr. Lea writes to the recipients describing the shipment and identifying special donors. The universities arrange transportation from ship to campus. Students and the universities' staffs get first choice of periodicals. Libraries get books and bound sets of transactions.

Technical journals and textbooks that are donated should be sent to: Engineers People-to-People Program, 36-02 Northern Boulevard, Long Island City 1, N. Y.

EJC News

• National Nuclear Congress

The next National Nuclear Congress will be held in New York City in 1962, according to an announcement made recently by Engineers Joint Council, sponsoring organization of the Congress. This decision by the Board of Directors of EJC was made public by EJC President Augustus B. Kinzel.

According to Dr. Kinzel, the change in policy of holding annual Congresses (which has been the schedule since its inception in December, 1955) to meetings in alternate years "reflects the current needs and interests of the engineering and scientific professions and the nuclear industry."

Lauchlin M. Currie, a pioneer in the nuclear energy industry and chairman of the EJC Nuclear Congress Committee, said, in connection with the EJC announcement of the policy change, that "Because of the present pace of development of nuclear technology, our Nuclear Congress Committee felt that it was in the best interests of the industry and its personnel and other participating organizations to have major international meetings and exhibits only once in two years. The basic purpose of the Congress with exhibits is to provide a means for all those in the nuclear energy field to exchange ideas and to review the latest innovations in the actual 'hardware' developed. EJC is confident that more fresh material will be available after a two-year interim. It also hopes that such an interval will insure more efficient preparation of vital new information and, at the same time, make its exchange more profitable.

"It is to be hoped that other engineering and scientific organizations interested in the nuclear field will also help to minimize demands on those directly connected with the nuclear industry," continued Dr. Currie. "This can be done by cutting down on the number and frequency of their own nuclear-oriented meetings and by joining with EJC in a major biennial meeting to serve the engineering and scientific communities as well as the nuclear industry."

The Nuclear Congress was first held in 1955 in Cleveland, then in 1957 in Philadelphia, in 1958 in Chicago, in 1959 again in Philadelphia, and in New York City this April. As many as 30 national engineering and scientific societies have co-operated with EJC in sponsoring the event, which also has included an international nuclear exposition, displaying everything from table-model reactors to full-sized working reactors. Government and education are represented in the Nuclear Congress as well as industry.

The 1962 Congress is being planned for the first week in June and will include technical sessions and industry exhibits.

• EJC Employment Conditions Committee Survey Available

The engineer generally is expected to determine for himself what information gained on one job he may utilize on a subsequent job—bearing in mind that he or his new employer may later be held legally accountable, according to a survey made by the Employment Conditions Committee of Engineers Joint Council.

Entitled "A Survey of Employer Practices and Expectations Concerning the Safeguarding of Proprietary Rights," the Committee's report presents the results of a questionnaire submitted to 800 major industrial companies which employ engineers.

Responses indicate that wide use is made of employment agreements which protect the current employer, but that only in rare instances are previous employee agreements investigated. "These former agreements, however, can and have formed the basis for legal actions with both the engineer and new employer as defendants," the report pointed out.

Almost one half of the employers responding disclosed that they use employee agreements to cover patent assignments, and nondisclosure of pro-

prietary information. Due to the difficulty in defining what constitutes trade secrets and confidential company information, inquiry was made to determine what type of instruction employees are given. About half of the employers feel their areas of confidential information are generally defined. Only 20 per cent give specific descriptions to new employees, and less than five per cent explicitly cover in termination interviews what is considered confidential information.

As in the case of the new employee, comments indicate a general attitude that reliance is placed almost solely on the terminating employee to distinguish between proprietary and general information.

Single copies of the Report may be obtained free from Engineers Joint Council, 29 West 39th Street, New York 18, N. Y. Costs of bulk quantities are available on request.

COMING MEETINGS

Machine Tool Exposition—1960

THE Machine Tool Exposition—1960, first since 1955, will be held in the International Amphitheatre in Chicago, Ill., Sept. 6–16, under the auspices of the National Machine Tool Builders' Association. More than 130 U. S. machine tool companies will exhibit 1050 of the latest models of American-built machine tools. The display will require 12 acres of floor space. Each machine will be designed for a particular type of work, but all will have common objectives—to improve production efficiency and cut costs. Machines displayed will reflect the rapid advances made since the last exposition in 1955 in the art of removing and shaping metal, application of numerical controls, development of accuracy, and the shift from operator control to automatic control.

Visitors to the exposition will be chiefly top executives of manufacturing companies, vice-presidents in charge of operation, plant managers, engineers, designers, men engaged in product development, production experts, and financial executives concerned with problems of cost reduction. Since this is a scientific exposition, many educators and government personnel will attend.

The machines displayed will be in operation. The visitor may study and compare the different machines, ask questions, and find out for himself just what machines best suit the requirements of his own plant. It is anticipated that the exposition may well touch off a new wave of plant modernization throughout the country's metalworking industry.

Instrumentation

THE 1960 Gordon Research Conference on instrumention will be held at Colby Junior College, New London, N. H., August 1–5. This conference is part of a summer program established to stimulate research in universities, research foundations, and industrial laboratories. Seventeen papers on various aspects of instrumentation will be presented to help bring participants up to date on latest developments in the field.

Rarefied Gas

THE Second International Symposium on Rarefied Gas Dynamics will meet on the Berkeley campus of the University of California, August 3–6. New developments in upper atmosphere research and space flight will be discussed along with more basic scientific studies.

Photography

TECHNIQUES in high-speed photographic measurement will be the subject of a seminar at Massachusetts Institute of Technology, Cambridge, Mass., August 15–19. Meetings will center at the Stroboscopic Light Laboratory. Subjects to be covered include pulsed stroboscopic lighting, optical high-speed cameras, Kerr cells, Faraday shutters, and image converters.

Cryogenic Engineering

CO-SPONSORED by the University of Colorado and the National Bureau of Standards, the 1960 Cryogenic Engineering Conference will be held at Boulder, Colo., August 23–25. The technical aspects of cryogenic engineering in the field below 150 K will be emphasized in papers presented.

MEETINGS OF OTHER SOCIETIES

●IN SOUTH AMERICA

July 18–23

Inter-American Nuclear Energy Commission, third inter-American symposium on the peaceful application of nuclear energy, Rio de Janeiro, Brazil.

●IN THE UNITED STATES

July 25–29

Permanent Committee and International Association on Occupational Health, 13th international congress on occupational health, Waldorf-Astoria Hotel, New York, N. Y.

Aug. 7–13

Columbia University, 11th annual industrial research conference, Arden House, Harriman, N. Y.

Aug. 8–11

American Astronautical Society, Western national meeting, Olympic Hotel, Seattle, Wash.

Aug. 8– 12

AIEE, Pacific general meeting, El Cortes Hotel, San Diego, Calif.

Aug. 14–17

AIChE-ASME, fourth national heat-transfer conference, Statler Hotel, Buffalo, N. Y.

Aug. 16–19

SAE, national West Coast meeting, Jack Tar Hotel, San Francisco, Calif.

●IN EUROPE

July 21–30

Nuclear Power Exhibition, Ltd., international nuclear power exhibition, Earls Court, London, England.

Aug. 15–20

International Astronautical Federation, 11th congress, Stockholm, Sweden.

Aug. 22–27

Koninklijk Instituut van Ingenieurs, seventh conference on coastal engineering, The Hague, Holland.

Aug. 28–13

Verein Deutscher Ingenieure-Hauptgruppe History of Technology in co-operation with the Deutsche Gesellschaft für Geschichte der Medizin, Naturwissenschaft und Technik (Bonn), Lüneburg, Germany.

Aug. 29–Sept. 3

Société Royale Belge des Ingenieurs et des Industriels, host to EUSEC Conference, Brussels, Belgium.

Aug. 29–Sept. 3

Czechoslovak Academy of Sciences-International Union of Pure and Applied Physics, fifth international conference on semiconductor physics, Prague, Czechoslovakia.

Aug. 31–Sept. 7

International congress of applied mechanics, Stresa, Italy.

Sept. 5–9

Czechoslovak Chemical Society, conference on chemical engineering science, Prague, Czechoslovakia.

Sept. 12–17

International Council of the Aeronautical Sciences, second congress, Zurich, Switzerland.

Sept. 16–20

Société Hydrotechnique de France, symposium

on "Hydraulic Turbine Research," Nice, France.

Sept. 21–23

VDI, Commission for Clean Air, Questions on Clean Air, Wiesbaden, West Germany.

Oct. 2–5

VDI, Society for Chemical Engineering in the Association of German Engineers, Mannheim, Germany.

Mid-October

VDI-Fachgruppe Vibration Engineering, vibration conference, Essen, Germany.

Oct. 17–19

K.I.v.I., International Congress on Plastics, Amsterdam, Holland.

Oct. 20–21

VDI-AWF-Fachgruppe Gear Engineering, international conference on gearing, Essen, Germany.

(For ASME Coming Events see page 109.)

LITERATURE

News In Pamphlets

Fuel Cells. "Some Plain Talk About Fuel Cells" is a 12-page, illustrated booklet discussing how fuel cells work, their problem areas, types under development, and special features of the new General Electric ion-membrane fuel cell. Booklet GED-4111 is available from General Electric Company, Schenectady 5, N. Y.

Space Data. "Space Facts," a 60-page handbook of basic and advanced space flight and environmental data including physics of space flight; navigation and guidance; communications in space; and bioastronautics and human factors is available from Product Information, Missile and Space Vehicle Department, General Electric Company, 3198 Chestnut Street, Philadelphia 4, Pa.

Basic Research. "Men and Motivation" by C. P. Rhoads, late director of the Sloan-Kettering Institute for Cancer Research, New York, N. Y., has been published. The booklet contains a discussion of the proper role of basic research and the true scientist given originally as an address to the Thomas Alva Edison Foundation. Available from: Thomas Alva Edison Foundation, 8 West 40th Street, New York 18, N. Y.

Small Business Handbook. "How to Build Profits by Controlling Costs," a 48-page booklet dealing with cost control from the point-of-view of the small businessman, has been published by Dun & Bradstreet, Inc. Available from: P. O. Box 803, Church Street Station, New York 8, N. Y., at $1 a copy.

Engineer-Scientist Creativity. In "Barriers to Creativity," industrial management will find new ways to recognize and overcome obstacles to the creativity process confronting technical professionals. The 30-page booklet is part of a series dealing with individual creativity prepared by Deutsch & Shea, Inc., New York, N. Y., technical manpower consultants. Copies are available singly for $1.50 or in quantity at special rates from Industrial Relations News, 230 West 41st Street, New York 36, N. Y.

Engineering Challenge. "Engineering's Great Challenge—the 1960's," three addresses given by Hilliard W. Paige, a General Electric Company executive, giving his views on the country's space effort, the Soviet threat, opportunities and challenges in engineering and education, have been published in pamphlet form. Available from: Public Information, General Electric Missile and Space Vehicle Department, 3198 Chestnut Street, Philadelphia 4, Pa.

Nuclear Fuel Elements. "Physical and Engineering Properties of Materials for Nuclear Fuel Elements" is a compendium of physical and engineering data about elements, alloys, compounds, and other materials of interest to those engaged in design, fabrication, and use of fuel and control elements. The 55-page booklet is available at $1 a copy from: Sylvania-Corning Nuclear Corporation, Bayside, L. I., N. Y.

Gas-Cooled Reactors

"Gas-Cooled Reactors," the proceedings of the symposium sponsored by The Franklin Institute and The American Nuclear Society, Delaware Valley Section, held Feb. 10–11, 1960, has been published. Available from: Journal of The Franklin Institute, 20th and The Parkway, Philadelphia 3, Pa., at $5 a copy.

Air-Conditioning Directory

The Directory of Certified Unitary Air-Conditioners, January 1–March 31, 1960, is available from: The Chief Engineer, Air-Conditioning and Refrigeration Institute, 1346 Connecticut Avenue, N. W., Washington 6, D. C.

National Science Foundation

"Science and Engineering in American Industry. Report on a 1956 Survey" presents results of a second comprehensive survey of industrial research and development conducted for the NSF by the U. S. Department of Labor, Bureau of Labor Statistics. Available at $0.70 a copy from: Superintendent of Documents, U. S. Government Printing Office, Washington 25, D. C.

Government Publications

Radiation Report. The National Academy of Sciences—National Research Council has issued a set of summary reports of its six Committees on the Biological Effects of Atomic Radiation which take a new look at the potential dangers of atomic radiation. An accompanying "Report to the Public," concludes that there is reason for caution but not concern. The report, prepared by more than 140 prominent scientists, was designed to bring up to date a similar report issued in 1956. In the new report, Detlev W. Bronk, Hon. Mem. ASME, president of the Academy, said that no new scientific information accumulated since 1956 should cause "drastic revision" of earlier recommendations.

Several of the committees' findings are as follows:

There is some new evidence that genetic effects from low radiation doses might be less than previously stated.

No new evidence has appeared to show that nuclear tests have affected the weather.

The disposal of radioactive wastes has not resulted in any significant hazard to the public, its environment, or its natural resources.

The report notes that there are still many unknowns about hazards associated with radiation sources. As new information is gained, man can expect to derive increasing benefits from the release of nuclear energy.

Copies of the Report to the Public and Summary Reports may be requested from the Information Office, National Academy of Sciences, 2101 Constitution Avenue, N. W., Washington 25, D. C.

Industry Outlook. "The U. S. Industrial Outlook for 1960," a 312-page compilation of background data, statistics, and prospects for 1960 in 89 selected industries is available at $1.50 a copy from the Superintendent of Documents, U. S. Government Printing Office, Washington 25, D. C., or any Department of Commerce Field Office.

Radiological Health. A new technical publication, "Radiological Health Data," is being published monthly by the Public Health Service of the Department of Health, Education, and Welfare. It is an outgrowth of a directive by the President that the department "intensify its radiological health efforts and have primary responsibility within the executive branch for the collation, analysis, and interpretation of data on environmental radiation levels." Data on radia-

tion levels in air, water, and milk comprise the bulk of the first issue. The price of the publication is $0.50 a copy or $3 for a six-month subscription. Available from: Office of Technical Services, U. S. Department of Commerce, Washington 25, D. C.

Oil-Shale Retort. "Bureau of Mines Gas-Combustion Retort for Oil Shale—A Study of the Effects of Process Variables" is a technical report describing experimental operation of a gas-combustion retort developed by the Bureau of Mines at Rifle, Colo., for extracting oil from oil shale, released from the Department of the Interior. Copies of Report of Investigations 5545 can be obtained from the Publications-Distribution Section, Bureau of Mines, 4800 Forbes Avenue, Pittsburgh 13, Pa.

Technical Subject Index. "Subject Index to Unclassified ASTIA Documents," a 2647-page, nine-volume works has been released. The index catalogs 40,000 unclassified publications of the Armed Services Technical Information Agency available to the public. Order PB-151567 at $30 a set from the Office of Technical Services, U. S. Department of Commerce, Washington 25, D. C.

Human Engineering. Five reports concerning effects of isolation, self-instructional devices, individual and group control of systems, intermember communication, and the trade-off of variables in decision making are available from the Office of Technical Services, U. S. Department of Commerce, Washington 25, D. C.

● "Studies in Human Isolation" reports isolation studies on 30 college-age subjects. Order PB161349 at $1.50 a copy.

● "Self-Instructional Devices: A Review of Current Concepts" contains a selective review of literature on the subject with emphasis on studies which provide for a functional analysis of these devices. Order PB161339 at $0.75 a copy.

● "A Comparison of One, Two, and Three-Man Control Units Under Various Conditions of Traffic Input Rate" makes a comparative evaluation of the effect of input load and team size on the productivity of a radar approach control unit. Order PB161045 at $0.75 a copy.

● "The Effect of Team Size and Intermember Communications on Decision-Making Performance" compares the performance of single individuals, two-man teams without intercommunication, and two-man teams with intercommunication in a complex decision-making task. Order PB151967 at $0.50 a copy.

● "Decision-Making Studies: Part I—The Trade-Off of Variables in Decision Making" reports how, in a simulated air-defense situation, subjects were required to make tactical decisions based on speeds, distance, and number of airplanes. Order PB161052 at $0.50 a copy.

AEC

● "USAEC Patents Available for Licensing," TID-4557 (1st Rev.), is a four-page pamphlet that briefly describes the scope of the Commission's patent portfolio, availability of patent abstracts, procedures for applying for patent licenses and applications for royalty, and the availability of patents. Available without charge from: Technical Information Service Extension, U. S. Atomic Energy Commission, P. O. Box 62, Oak Ridge, Tenn.

● "What's Available in the Atomic Energy Literature," TID-4550 (6th Rev.), a 43-page booklet explaining what unclassified atomic energy research information is available, how to locate and use this information, and how it may be obtained has been published. Guidance is furnished for locating, obtaining, and using the information announced in abstract journals, indexes, bibliographies, and other guides issued by the USAEC. Available from: Technical Information Service, U. S. Atomic Energy Commission, Oak Ridge, Tenn.

● "Proceedings of Technical Meetings" is a 29-page catalog listing and describing published proceedings of 126 selected meetings, conferences, and symposia held during the past ten years in which the Commission or its contractors were sponsors, cosponsors, or major participants. Availability and price of proceedings for each meeting listed are shown. Available without charge from: Technical Information Service Extension, P. O. Box E, Oak Ridge, Tenn.

● A revised version of "Special Sources of Information on Isotopes," TID-4563, has been published. Contained in the 51-page booklet are lists of more than 300 informational references and their availability. The references were selected as the most comprehensive items from thousands of reports and articles published on the nature and uses of radioactive and stable isotopes. Available without charge from: Office of Isotopes Development, U. S. Atomic Energy Commission, Washington 25, D. C.

● The third "Quarterly Statement on Fallout" has been issued. It summarizes the latest information on surface air radioactivity, monthly fallout collections, radioactivity in milk, other foods, and human bone, and results of stratospheric studies. Available from: U. S. Atomic Energy Commission, Washington 25, D. C.

● "Power Cost Normalization Studies, Civilian Power Reactor Programs-1959," SL-1674, including text, tables, graphs, and fold-out engineering drawings related to cost estimates for eight power-reactor concepts has been published. Available from: U. S. Atomic Energy Commission, Washington 25, D. C.

● "Potential Nonnuclear Uses for Depleted Uranium," TID-8203, a 58-page report discusses industrial uses and markets for uranium and its products; physical and chemical properties of depleted uranium and its compounds; and health and safety hazards involved in industrial usage of depleted uranium. Available at $0.75 a copy from: Office of Technical Services, U. S. Department of Commerce, Washington 25, D. C.

● "Proceedings of the 1959 Symposium on Low-Temperature Nuclear Process Heat," TID-7580, includes coverage of results of AEC surveys of domestic process heat requirements, and technical and economic factors peculiar to low-temperature process heat reactors. Available at $0.75 a copy from: Office of Technical Services, U. S. Department of Commerce, Washington, 25, D. C.

● "Radioisotopes in Science and Industry" summarizes AEC's Isotopes Development Program which is aimed toward accelerating the peaceful uses of radiation and reactor by-products. It cites some of the major milestones in isotopes development and uses of radioisotopes and radiation in agriculture and plant studies. Available at $1.25 a copy from: Superintendent of Documents, Government Printing Office, Washington 25, D. C.

● "Possible Large-Scale Uses of Separated Fission Products," TID-8521, summarizes potential large-scale uses of separated fission products; the types of possible applications and the problems that may be associated with such uses; and specific fission products of interest for large-scale use. Available at $0.50 a copy from: Office of Technical Services, U. S. Department of Commerce, Washington 25, D. C.

EDUCATION

Campus Improvements

● Case Institute of Technology has three major building programs under way. The latest to start is a $1.1 million

Joseph Waitkus, **left,** Mem. ASME and manager of marine sales for the Air Preheater Corporation, presents a working model, scaled to 1/4 the size of a typical manufactured unit and designed to perform all operations of regular working units, and diagram of the Ljungstrom (R) marine air preheater to Rear Admiral Gordon McLintock, Superintendent of the United States Merchant Marine Academy at Kings Point, N. Y.

modification of the interior of the Bingham Mechanical Engineering Building. Under construction are a $2.5-million Library-Humanities Building and a $2.3-million Metallurgical Building.

● Newark College of Engineering dedicated its new $1.5-million Weston Hall, May 26, 1960. The seven-story building, containing 15 laboratory areas, a 417-seat lecture hall, library, gymnasium, bookstore, and offices, honors the Edward Westons, father and son, whose relationships with the 75-year-old institution date from 1885 to the present.

● The University of Rochester is planning to spend $2,750,000 to expand science and engineering facilities. Part of the $49.9-million Greater University Program launched last fall, the project will include a five-story science building, increased facilities for engineering and research in optics, and a 350-seat lecture-demonstration hall.

Fellowships and Scholarships

● Gordon J. Murphy, director of the information and data processing laboratory, Northwestern University, has been selected winner of the first grant given by The Foundation for Instrumentation Education and Research, Inc., for interdisciplinary research in instrumentation and automatic control technology. Dr. Murphy will spend a year in research involving the application of modern feedback control theory to the design of production and inventory systems.

● The 1960 FIER-Link In-Industry Scholars have been chosen. Morton B. Friedman, assistant professor of civil engineering in the Institute of Flight Structures, Columbia University, has been named the Grumman Scholar. He will spend a one-month study period at Grumman Aircraft Engineering Company, L. I., N. Y., observing and working with modern techniques of test instrumentation on flight structures. Leslie A. Geddes, assistant professor of physiology at the Baylor University College of Medicine and director of the institution's laboratory of biophysics, was named the Chance-Vought Scholar and will devote his study period to the instrumentation aspects of simulation and man-machine integration in space systems at Chance-Vought Aircraft Company, Dallas, Texas. The in-industry scholarship provides each man with $500 donated by the Link Foundation to FIER and an equal sum from the sponsor company.

● Fourteen graduate fellowships have been awarded by FIER for study in the engineering sciences related to instrumentation. Those who will receive full tuition for the academic year, 1960–1961, plus a $1500 cost-of-living stipend while studying for MS or PhD degrees are: Keith H. Banko, John W. Bernard, Louis P. Bosanquet, Paul K. Boyd, Robert C. Boyer, Assoc. Mem. ASME, Thomas J. Boyle, Wilburn O. Clark, John Cotter, Richard Kermode, Donald R. Kerr, George Kovatch, Bernard E. Pennock, Robert J. Schiller, and George W. Smith. Each university where the fellow is studying will receive a $1000 cost-of-education grant.

● A $10,000 scholarship program has been established by The Emmet Blakeney Gleason Memorial Fund at the University of Rochester's College of Engineering. The program will aid two or more entering freshmen who plan to study engineering at the university. Awards will be made on the basis of scholastic promise, motivation for engineering as a career, and financial need.

New Programs

● **IBM.** To help increase the new class of computer professionals in the U. S., IBM will inaugurate the IBM Systems Research Institute to be located on United Nations Plaza, New York City. The first of its kind in the computer industry, this graduate-level school will train people to find computer system solutions to the most complex business and scientific problems. Thirty students will be enrolled in the fall.

● **Marquette University.** A co-operative graduate program in engineering for Milwaukee industry will be initiated by Marquette University next fall in the fields of electrical and mechanical engineering. Selected engineers from participating companies will be able to earn master's degrees within two years by spending four months each year as full-time students and completing thesis requirements during work periods in industry.

Space Academy

Formation of an International Academy of Astronautics to provide world technical leadership for the peaceful conquering of space and to serve as a clearing house for astronautic information has been announced by the International Astronautical Federation and the Daniel and Florence Guggenheim Foundation.

The Academy, which will be financed the first three years by the Guggenheim Foundation, will be composed of the world's leading scientists representing the basic sciences, engineering and life sciences, and the major fields involved in the development of astronautics, and will be a part of the Federation.

It will bring together the world's outstanding scientists and engineers to further the more rapid developments of space flight and related sciences.

Dr. Theodore von Karman, Mem. ASME, chairman of the Academy's founding committee, declared that the new association will provide "what may be the only common intellectual meeting ground" for the scientists and engineers of all nations.

Industrial Engineering

Newark College of Engineering has received approval by the State Board of Education to grant the degree of Bachelor of Science in Industrial Engineering. Oliver J. Sizelove, Mem. ASME, chairman of the department of industrial and management engineering, under which the degree will be given, stated that the new curriculum, to start in September, 1960, is the latest in a series of steps in the evolution of industrial engineering at the college.

Nuclear Engineering

The Atomic Energy Commission has made a grant for a study of the education of the nation's nuclear engineers. Sponsored by the American Society for Engineering Education and the American Nuclear Society, a committee of 30 nuclear engineering experts from educational institutions, industry, and government research groups will study the philosophies underlying programs and objectives of nuclear engineering education. The group, known as the Committee on Objective Criteria for Nuclear

Engineering Education, will endeavor to establish program guideposts for future use in universities. Glenn Murphy, Mem. ASME, head of the department of theoretical and applied mechanics at Iowa State University, is chairman of the study committee.

Youth Science Center

A GIANT stride in the international race to produce "quality" scientists has been taken by Nasson College of Springvale, Maine, a small New England college, in the first step to create a National Youth Science Center. Nasson has been named to administer the bold and imaginative program of the Center under an $18,000 grant from the National Science Foundation.

At Nasson the initial grant will make it possible for 50 high-ability secondary-school students throughout the nation to be accommodated on campus for a six-week summer session starting June 27. Next year, when additional facilities and funds are expected to become available, plans are for the program to be continued on Cushing Island off Portland, Maine, to be renamed Science Island.

It is planned for the Center to be self-supporting after the initial year. A nonprofit corporation, the National Youth Science Foundation was organized a year ago to perpetuate the work of the Center through private financial sources. The Foundation later will provide Nasson with the necessary financial support and other services for a continuation of the summer program.

There will be a minimum of formal education during the session—youngsters will engage in projects of their own choosing and carry them out under the supervision of capable teachers.

Origin of the Center started in the home of David L. Lukens, New Jersey business executive, when an overzealous housekeeper complained to the Society for the Prevention of Cruelty to Animals when Mr. Lukens' son dissected a frog.

Seeking a method to channel the bright youngster's talents, Mr. Lukens hit on the idea of a youth center where the boy could receive guidance under competent scientists. He consulted with Dr. Vannevar Bush, Hon. Mem. ASME, board chairman of M.I.T., and Dr. Harry C. Kelly, associate director of the National Science Foundation. With encouragement from these men and others the plan got under way. The major part of Cushing Island was purchased as the site for the Center. Then followed three years of planning before the project was ready to begin.

The objectives of the National Youth Science Center are to uncover America's most able youngsters in their most formative secondary-school years and provide opportunity, guidance, and inspiration to become worthy and dedicated scientists.

Youngsters will be accepted for the NYSC only if they are qualified by ability. Future plans call for the establishment of "campships" for the summer session which may be sponsored by any American industry, union, association, or individual through the NYSF.

PEOPLE

Honors and Awards. ALEXANDER GRAHAM CHRISTIE, Hon. Mem. and past-president, ASME, and emeritus-professor of mechanical engineering, The Johns Hopkins University, Baltimore, Md., was given a citation by the Regents of the University of Wisconsin for his contributions in the field of education and in the engineering profession.

PHILIP SPORN, Hon. Mem. ASME, president of American Electric Power Company, was presented the annual Conservation Service Award of the U. S. Department of Interior in recognition of the valuable services rendered as proponent of conservation of fuels of the U. S. He was cited specifically for the advanced design and operation of the heat pump, improvements in transmission of electricity at high voltages, and pioneering in generation by steam operating at high temperatures and pressures.

ERNEST O. KIRKENDALL, secretary of AIME, has received an Alumni Award from Wayne State University, Detroit, Mich., for his discovery of a phenomenon in diffusion in solid metals now known as the "Kirkendall Effect."

Certificates of Honorary Membership in The Engineering Institute of Canada—the highest form of recognition given by the Institute—were presented to BRISTOW GUY BALLARD, vice-president of the National Research Council of Canada and director of the Division of Radio and Electrical Engineering; to WILLIAM PERCY DOBSON, RICHARD L. HEARN, and OTTO HOLDEN who have been closely associated with the Hydro-Electric Power Commission of Ontario for many years; and to JOHN NORISON FINLAYSON, former president of the Institute and former Dean of the Faculty of Applied Sciences of the University of Columbia.

CLARENCE DECATUR HOWE, Hon. Mem. ASME, consulting engineer and former Cabinet Minister in the Canadian Government, and HUGH ANDREW YOUNG, Deputy Minister of the Department of Public Works of the Dominion Government, were named recipients of the EIC Julian C. Smith Medals awarded for achievement in the development of Canada.

The Leonard Medal, presented for papers on mining subjects, was won by VICTOR DOLMAGE and J. W. STEWART of Dolmage, Mason, and Stewart, Ltd. The Plummer Medal was awarded to J. T. HUGILL, Canadian Liquid Air Company, Ltd., for the best paper on a metallurgical subject. A. G. DAVENPORT of the department of civil engineering, University of Bristol, England, received the Duggan Medal and Prize. J. J. TRAILL, consulting hydraulic engineer, Toronto, won the Robert W. Angus Medal. All presentations were made at a Special Awards Luncheon held during the EIC Annual Meeting at the Royal Alexandra Hotel, Winnipeg, Manitoba, Canada, May 26, 1960.

AUGUSTUS B. KINZEL, vice-president—research, Union Carbide Corporation, received the Industrial Research Institute's 1960 medal which is awarded "annually for outstanding accomplishment in leadership in or management of industrial research," at the annual meeting of the Industrial Research Institute held at Virginia Beach, Va., in May.

The Public Welfare Medal of the National Academy of Sciences awarded for "eminence in the application of science to the public welfare" was presented to ALAN T. WATERMAN, director of the National Science Foundation, at the Academy's 97th annual meeting held in Washington, D. C., April 26, 1960.

Honorary Degrees. Case Institute of Technology, Cleveland, Ohio, conferred honorary degrees on prominent scientists at their 84th Commencement, June 2, 1960. T. KEITH GLENNAN, president-on-leave of Case and administrator of the National Aeronautics and Space Administration, and SIMON RAMO, member of the Case Board of Trustees and executive vice-president of Thompson-Ramo-Wooldridge, each received an honorary degree of Doctor of Engineering.

Recipients of the honorary Doctor of Science degree were: HERBERT F. YORK, director of research and engineering for the Department of Defense; ELLIS A. JOHNSON, director of the operations research office of The Johns Hopkins University; and GEORGE E. UHLENBECK, Henry S. Carhart professor of physics at the University of Michigan.

Campus Data. LLOYD H. DONNELL, Mem. ASME, research professor of mechanics at Illinois Institute of Technology, Chicago, Ill., has been appointed senior research scientist in The University of Michigan's Institute of Science and Technology for the 1960–1961 academic year. Dr. Donnell formulated the well-known Donnell Equations which form a basis for the solution of present-day problems in the field of light structures. In his new appointment he will conduct lectures, seminars, and research in the fields of light structures, aerostructures, aeroelasticity, and shell theory.

E. A. TRABANT, Mem. ASME, head of the Division of Engineering Sciences and professor of engineering sciences at Purdue University, was named Dean of the University of Buffalo School of Engineering. He will assume the position July 1.

WILLIAM S. CLOUSER, Assoc. Mem. ASME, assistant professor of engineering mechanics at the University of Wisconsin, has been appointed a visiting assistant professor of engineering mechanics at the University of Michigan.

MARTIN LESSEN, Mem. ASME, professor of applied mechanics and chairman of the Division of Engineering Mechanics at the University of Pennsylvania, was appointed professor of mechanical engineering and chairman of the department at the University of Rochester.

A. PEMBERTON JOHNSON, Mem. ASME, was appointed director of the counseling center at Newark College of Engineering after serving as assistant director since 1956.

HOWARD J. HENRY, Mem. ASME, previously director of engineering, Chicago Pneumatic Tool Company, has been named Dean of the School of Engineering of Southern Methodist University, Dallas, Texas.

PETER ALTMAN, vice-president of Continental Motors Corporation, will head the newly formed University of Detroit Research Advisory Board which will review research now being done by the University and recommend methods of procedure and of expanding activity. Among the 18 engineers and industrialists who formed the Board is CHARLES G. DUNCOMBE, director of the University of Detroit Research Institute of Science and Engineering.

Gillett Lecture. R. CARSON DALZELL, Mem. ASME, assistant to the director of the Division of Reactor Development, U. S. Atomic Energy Commission, presented the eighth Gillett Memorial Lecture at the 63rd annual meeting of the American Society for Testing Materials at Chalfonte-Haddon Hall, Atlantic City, N. J., June 28, 1960. Dr. Dalzell outlined the scientific problems and the engineering economic considerations in the standardization of fuel elements.

New Officers. BROTHER AMANDUS LEO, F.S.C., Dean of the School of Engineering at Manhattan College, has been elected president of the Association of Engineering Colleges of New York State for 1960–1961. Brother Leo succeeds DR. EDWARD MCHUGH, Mem. ASME, Dean of Faculty at Clarkson College of Technology, Potsdam, N. Y., who served four years as president.

L. O. WITZENBURG, Cleveland Worm & Gear Division, Eaton Manufacturing Company, Cleveland, Ohio, has been elected president of The American Society of Lubrication Engineers. ANDREW E. CICHELLI, Assoc. Mem. ASME, Bethlehem Steel Corporation, Bethlehem, Pa., was re-elected as secretary. ALBERT A. RAIMONDI, Assoc. Mem. ASME, Westinghouse Research Laboratories, Pittsburgh, Pa., was elected to serve as director of the society for a three-year term.

NORMAN J. DUNBECK, vice-president, International Minerals and Chemical Corporation, Skokie, Ill., was chosen national president, 1960–1961, of the American Foundrymen's Society, during the society's Castings Congress and Exposition in Philadelphia, Pa. ALBERT L. HUNT, executive vice-president, Superior Foundry, Inc., Cleveland, Ohio, was elected vice-president.

WALTER A. GRANT, vice-president and director of engineering, Carrier Corporation, Syracuse, N. Y., was installed as president of the American Society of Heating, Refrigerating, and Air-Conditioning Engineers at the society's annual meeting in Vancouver, B. C., Canada, June 13–15. R. H. TULL, manager, Product Engineering Department, Westinghouse Electric Corporation, Columbus, Ohio, will become first vice-president. JOHN EVERETTS, JR., consulting engineer, C. S. Leopold, Inc., Philadelphia, Pa., will be second vice-president.

R. D. THOMAS, Jr., president of the Arcos Corporation, Philadelphia, Pa., was installed as president, 1960–1961, of the American Welding Society at their annual meeting held at the Hotel Biltmore, Los Angeles, Calif. Mr. Thomas was elected first vice-president in 1959 and received the Miller Medal in 1958, one of the highest honors conferred by AWS.

BERNARD KEARNEY has been elected president of the New York and New Jersey Branch of the National Metal Trades Association which is active in promoting sound industrial relations, supervisory training, and employee education among member companies. Mr. Kearney is president of The Torsion Balance Company, Clifton, N. J.

ERIC A. SALO, Mem. ASME, supervisor of steam-power generation, Pacific Gas and Electric Company, San Francisco, Calif., has been elected vice-chairman of the San Francisco Advisory Committee of Engineering Societies Personnel Service, Inc. Mr. Salo has served

Consul H. E. Berenz, **left,** of the German Consulate General in Chicago, Ill., presents scroll to Hunter Hughes, Mem. ASME, editor, "Consulting Engineer," during a ceremony held at the Chicago Engineers' Club. Mr. Hughes has been elected unanimously the first and only honorary member of the Berlin Section of the Association of Consulting Engineers of Germany.

Greetings are extended at ASME Regional Student Conference by Stewart Carpenter, center, chairman of Newark College of Engineering chapter and host. Gordon R. Hahn, left, Gibbs & Hill, Inc., was presented with NCE's 75th Anniversary Citizen Citation. R. E. Abbott, right, "Product Engineering," accepted a similar award for A. M. Perrin, president, National Conveyors Company, Inc., and a director of ASME.

First-Place Winner Alfred P. Meyer, center, of Stevens Institute of Technology is congratulated by W. C. Krutzch, chief engineer for Worthington Corp. and one of three judges at ASME regional student conference held April 23 at Newark College of Engineering. At right is chapter's faculty adviser Eugene Stamper, assistant professor in mechanical engineering.

on this committee which guides engineering employment aid in the Western states regional office, providing placement service to employers and engineers.

ROBERT G. CHOLLAR, vice-president of research and development and member of the board of directors, National Cash Register Company, Dayton, Ohio, has been elected president of Industrial Research Institute, Inc. HOWARD S. TURNER, vice-president of research and development, Jones & Laughlin Steel Corporation, Pittsburgh, Pa., was elected the Institute's vice-president and president-elect.

O. A. SAUNDERS, professor and head of the Department of Mechanical Engineering, City and Guilds College, has been elected president of The Institution of Mechanical Engineers. Professor Saunders is also dean of the City and Guilds College and has been closely associated with the academic and building plans of the new college.

Among the newly elected officers of the American Gear Manufacturers Association are JAMES F. MURRAY, president of Winsmith, Inc., Springville, N. Y., president; CHARLES F. BANNAN, vice-president of Western Gear Corporation, Lynwood, Calif., vice-president—Products Division; FOLKE RICHARDZ, Mem. ASME, consulting specialist with Westinghouse Electric Corporation, Buffalo, N. Y., vice-president—Technical Division; and J. H. HARPER JACKSON, sales manager of Jackson Gear Company, Pittsburgh, Pa., treasurer.

ROBERT S. SHANKLAND, Ambrose Swasey Professor of Physics at Case Institute of Technology, Cleveland, Ohio, was elected president of the Associated Midwest Universities, a corporation organized to encourage and conduct research and education in all branches of science and to develop programs involving use of Argonne National Laboratory and other laboratories. Dean W. L. EVERITT, College of Engineering, University of Illinois, was elected vice-president of the corporation; and A. T. SCHMEHLING of Northwestern University was re-elected treasurer.

JAMES P. KNEUBUHL has been elected president of Research-Cottrell, Inc., Bound Brook, N. J., one of the leading U. S. manufacturers of electrical precipitators and other industrial gas-cleaning equipment. Mr. Kneubuhl was formerly vice-president in charge of utility and government sales, The Fluor Corporation, Ltd., Los Angeles, Calif.

ERIC A. WALKER, president of The Pennsylvania State University, is the new president of the American Society for Engineering Education. MELVIN R. LOHMANN, Oklahoma State University, and NEWMAN A. HALL, Mem. ASME, Yale University, have been chosen vice-presidents. WENDEL W. BURTON, Minnesota Mining and Manufacturing Company, has been renamed treasurer.

GEORGE MCKINSTRY DICK, Mem. ASME, was inducted into the office of president of The Engineering Institute of Canada at their 74th annual banquet held at the Royal Alexandra Hotel, Winnipeg, Manitoba, Canada, May 27, 1960. New vice-presidents of the Institute are T. C. HIGGINSON, EDGAR A. CROSS, and CHARLES MILLER.

PAUL S. REIS, Assoc. Mem. ASME, senior engineer for Aerojet-General Corporation, Sacramento, Calif., has founded a Tau Beta Pi alumnus chapter in Sacramento and has been elected its first president.

ANTOINE MARC GAUDIN of M.I.T. has been elected chairman of the Engineering Foundation, a department of United Engineering Trustees, Inc., which acts as the research federation of UET's constituent societies—ASME, ASCE, AIEE, AIChE, and AIME. GEORGE O. CURME, JR., a director of Union Carbide Corporation, has been chosen vice-chairman, and H. K. WORK, associate dean and director of research at New York University, has been named director of the Foundation.

RALPH L. GOETZENBERGER, Fellow ASME, is the first of five technical specialists to be sent to the Far East to assist Japanese industry improve production methods and techniques by the Work-Factor Company, Inc., Haddonfield, N. J., at the request of the U. S. State Department. Mr. Goetzenberger is now an educational consultant and a Work-Factor instrumentation specialist. He is retired vice-president of both Minneapolis-Honeywell Regulator Company, Minneapolis, Minn., and its Brown Instrument Division, Philadelphia, Pa.

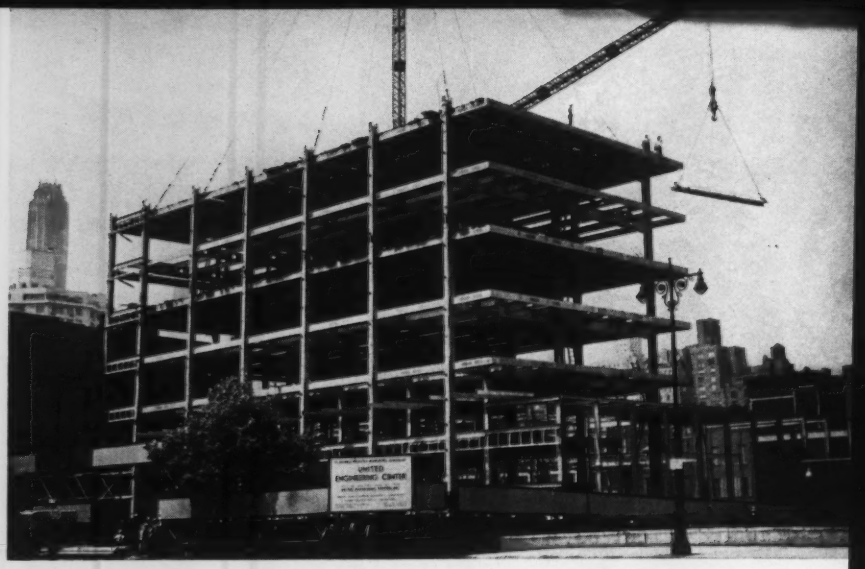
Appointment of DR. EDWARD A. SAIBEL, Mem. ASME, as chairman of the Department of Mechanics, and the retirement of DR. WILLIAM R. OSGOOD, Mem. ASME, as head of the department at Rensselaer Polytechnic Institute, have been announced.

Among five U. S. representatives named to Technical Study Committees of CIGRÉ—The International Conference on Large Electric Systems—by the U. S. National Committee for 1960 is L. R. GATY, Mem. ASME, vice-president of research and development, Philadelphia Electric Company.

PETER P. WEGENER, noted research engineer in the field of guided missiles and satellite aerodynamics, has been appointed professor of mechanical engineering at Yale University, New Haven, Conn.

SCORE BY SECTIONS AS OF JUNE 1, 1960

SECTION	Per Cent of Quota
Waterbury	181
Cincinnati	162
Canton-Alliance-Massillon	150
Dayton	144
Hudson Mohawk	136
N. W. Florida	132
Youngstown	130
West Virginia	130
Worcester	128
Atlanta	124
Hawaii	116
Providence	113
Columbia Basin	112
Metropolitan	108
Westmoreland	106
Detroit	106
Central Indiana	105
Central Iowa	105
Olean	105
Southern Tier	102
San Diego	102
Fort Wayne	100
▲ OVER 100% / UNDER 100% ▼	
Erie	96
Fairfield County	94
North Alabama-Mississippi	90
Birmingham	90
Pittsburgh	90
Sabine	87
Rock River Valley	87
Milwaukee	86
Anthracite-Lehigh	85
Cleveland	85
Rochester	85
Piedmont-Carolina	84
Kansas City	83
Minnesota	82
Iowa-Illinois	81
Delaware	80
Mid-Hudson	77
UNDER 75%	
Columbus	74
Susquehanna	71
Nebraska	70
Akron	68
Chicago	66
Central Savannah River Area	66
New London	66
Toledo	65
Syracuse	64
Baltimore	62
East Tennessee	61
Boston	57
Central Illinois	57
Eastern Virginia	57
West Washington	57
Central Michigan	55
Mid-Jersey	53
Arizona	51
Western Massachusetts	51
New Haven	50
UNDER 50%	
Philadelphia	49
St. Louis	45
Oregon	44
Utah	44
Inland Empire	43
Central Kansas	42
New Mexico	41
Mexico	40
San Francisco	40
South Texas	40
Greenville	36
Buffalo	35
Hartford	34
Mid-Continent	34
Ontario	34
Washington, D. C.	34
Mohawk Valley	33
Rocky Mountain	31
Savannah	29
Los Angeles	28
Eastern North Carolina	26
Florida	25
Louisville	25
UNDER 25%	
Central Pennsylvania	22
New Orleans	22
Virginia	21
North Texas	20
Miami	19
St. Joseph Valley	18
Chattanooga	17
North New England	16
Central Virginia	15



United Engineering Center

Going up! Steelwork reaches sixth floor of United Engineering Center being constructed in New York City.

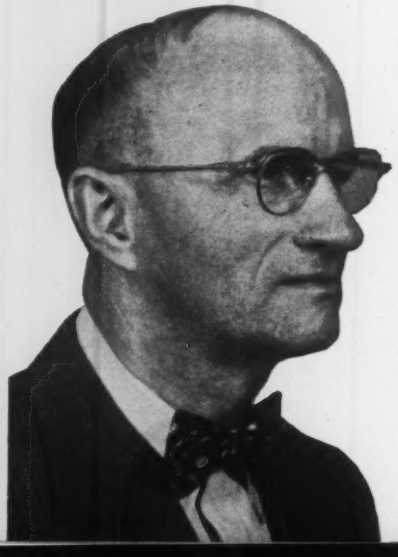
Region V First Over the Top in ASME Member Gifts Campaign

Region V, under the leadership of Ernst W. Allardt, was the first of ASME's eight Regions to achieve its quota for the Member Gifts Campaign on behalf of the United Engineering Center. Ohio, Michigan, Western Pennsylvania, West Virginia, and Ontario, Canada, comprise the territory of Region V. Region II (Greater Metropolitan area of New York City) closely followed Region V in going over the top.

Mr. Allardt, chief engineer of The Babcock & Wilcox Company Tubular Products Division and past Vice-President of Region V, has headed the fund-raising drive there since its beginning.

Said one Section Chairman, "While I don't want to take any credit away from the wonderful group working with me in our own Section, I think all of us recognize that Ernie Allardt's inspired leadership, more than any other factor, has been responsible for the success of this effort, and it has proved to be an inspiration to all those involved in the national campaign. His ability, thought, and work should certainly be recognized as an outstanding contribution to the future home of engineering in America."

E. W. Allardt, whose leadership never faltered, gets Region V "over the top" first in the ASME Member Gifts Campaing



There Shall Be a UEC— Says U. of Michigan Student Section With Money

Amid reports from many parts of the country indicating that only a minority of ASME members are supporting the United Engineering Center Gifts Campaign, comes news that the University of Michigan Student Section of ASME, entirely on its own initiative, has made (and paid) its pledge. Said Albert Chapman, Chairman of the Member Gifts Committee in the area that received the pledge, "This contribution has impressed me a great deal. It is a concrete demonstration of the faith that our younger engineers, at least, have in their profession."

Notes on Society Activities and Events

E. S. NEWMAN
News Editor

THE ASME NEWS

Solid Technical Program and Show, Inspection of TWA International Overhaul Base, Make Up a Busy Five-Day ASME Oil and Gas Power Conference in Kansas City, Mo.

SITTING through a Civil Defense Drill and learning later that it was a tornado warning, and finding out that "white-face cattle" are properly called Herefords are among the things that can happen when one goes to Kansas City.

If you had attended the Oil and Gas Power Conference and Exhibit of The American Society of Mechanical Engineers at the Hotel Muehlebach, May 22–26, 1960, there would be other surprises. You would be in an ultramodern hotel only two blocks from Macy's and in a bustling metropolitan area that just passed the 1,200,000 mark and that many regard as the finest of midwestern cities.

Furthermore, you would have found that the Oil and Gas Power Division knows how to plan a straight-through-type program that allows time for sociability and interesting things to do. Las Vegas night provided good husband-and-wife fun with provision for grass bachelors, too. Lots of paper stage money and good door prizes drew more than half of the conference attenders. Baseball fans had their outing on Tuesday night when they watched the Kansas City Athletics trounce the Boston Red Sox 6 to 2.

Technical Program

There was a good solid technical program, too. There were two papers on power costs for the small utility system. One was a Rural Electrification Administration study of a small operating system (54-mw capability) that required a substantial addition to its power supply. Some purchased power was available and a diesel plant was proposed. The method of figuring the interrelated factors and arriving at the most economical solution was illustrated. The other paper was a consulting engineering firm's cost comparisons of diesel and steam. The OGP Power Cost Committee also met during the conference.

The performance of diesel and dual-fuel diesel-engine-driven generating units for peaking and standby-power service in six steam-electric generating stations in Kansas was the topic of another paper.

When a 3525-kw diesel-engine a-c generating unit that was interconnected to a large system began to show wide power swings, an analysis was made to isolate the effects of generator, power system, and load, and the engine governor and fuel supply. The co-operative efforts of engine, governor, and generator manufacturers led to a simple procedure which can be used to determine in advance whether such disturbance might occur.

The development of an electric-load-sensing, hydraulically operated governor for small power-generating units was described. It is backed up by an interconnected ball-type speed governor and load is controlled through the fuel supply.

A survey of piston-ring design and application practice for modern large-bore diesel and gas engines brought a comment on the degree to which piston-ring design has settled down in the past few years.

Development of the Alco 251 engine, turbochargers for the General Motors series 567 engines, a nozzle design to cut locomotive-fuel costs, and a two-cycle diesel-engine waste-heat exchanger were other topics. There was also a detailed presentation of a laboratory gas-engine lubricant study.

The growth, economics of application, and other details of the natural-gas industry were presented in a paper entitled "Horsepower to Heat the Nation."

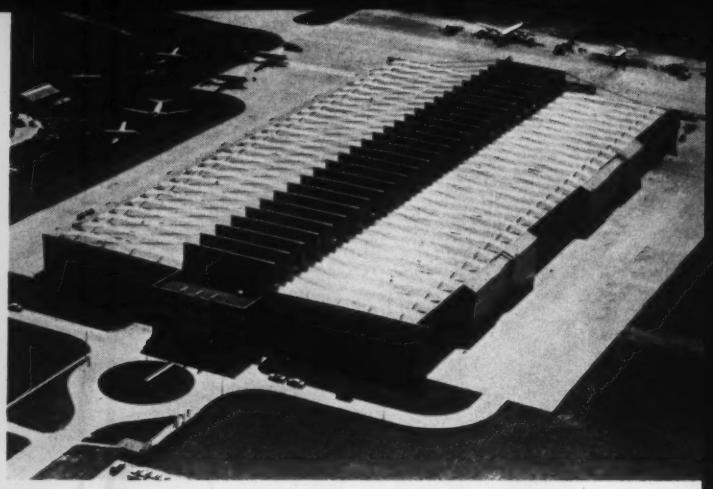
The most controversy centered around the final paper which was on the application and range of the tuned-housing vibration damper. The opposition centered on Professor Georgian of Washington University (St. Louis) who maintained that the whole approach was wrong. He stated that the shaft should have been designed heavy enough to eliminate vibrations and to keep resonances above the operating range in the first place. The author maintained that the cost would have been prohibitive and the bulk too great.

Panel Discussion

The use of spectrographic analysis in the preventive maintenance of internal-combustion engines was the topic of a panel discussion. H. R. Sennstrom, Mem. ASME, vice-president, engineering and sales, American Bosch Arma Corporation, termed the method in effect a means of seeing what is happening inside the engine and what is needed for preventive maintenance.

Ray McBrian, Mem. ASME, director of research, Denver and Rio Grande Western Railroad Company, the company which originated spectrographic control,

Distinguished guests at the head table rise to be introduced at the Oil and Gas Power Conference banquet



On inspection trip to TWA International Overhaul Base, one saw a structure 1000 ft × 420 ft. The center includes an adjoining engine overhaul building and test cells.

told how it came about. In 1939 a college professor had used spectrographic analyses of the mineral content of soil to predict where ore bodies could be located. The company thought that it might have value for the preventive maintenance of engines and had an instrument built for less than $1000 that is still in use. At first it was used only for qualitative analysis—merely to see what metals were present. Tests are now made on each diesel locomotive engine as soon as it is put in service to provide a base line, since it is the increase in each metal for each individual engine that is important.

Arthur C. Davis, diesel engineer, Standard Oil Company of Indiana, stated that the company "viewed spectrographic analysis with mixed emotions" since it provided an accuracy of only ±15 per cent on routine basis, although with controls this could be raised to ±3 per cent; however, wet-analysis methods were better when that degree of accuracy was desired. They do regard it as one of a number of analytical methods.

John W. Barna, compressor and lubrication engineer, Union Carbide Chemicals Company, stated that Union Carbide became interested when four outlying stations—each equipped with two 1100-rpm 250-hp engines for driving pumps—began to give trouble. Oil was being changed every seven days and spark plugs every two weeks in an effort to stop the trouble. It was found that metals present in a few parts per million indicated where excessive wear was taking place. They found nine metals particularly important—Na, Cr, Cu, Fe, Pb, Si, Sn, Al, and Ag—and that an increasing indication of a combination of Cu and Pb, for example, indicated an impending radiator failure. An $8000 annual cost of running analyses saves them $18,000 net a year. This compared with D&RGW savings of $3000 per year per locomotive, amounting to $675,000 annually. The railroad also saves 1 cent a mile on the cost of auto trucks by applying it there. The cheapest fuels available are purchased, and yet engine conditions are adequately controlled with the spectrograph.

D&RGW continues to use the 300,000-mile overhaul rather than base shopping on spectrographic analyses. Clean oil is regarded as paramount in maintenance, filters are changed every week, and oil is frequently used for as much as 1,000,000 miles.

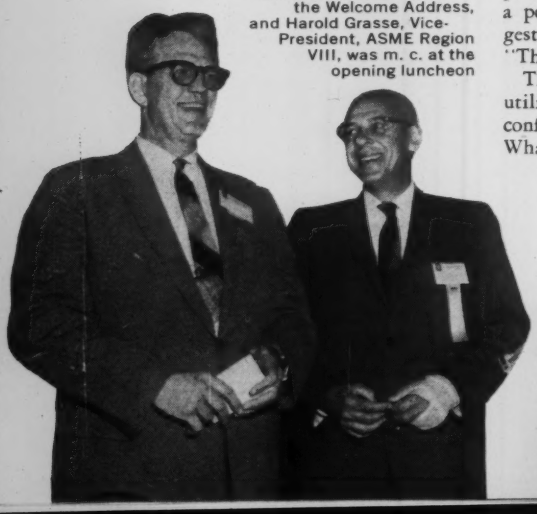
R. A. Wells, staff products application engineer, Gulf Research and Development Company, emphasized that spectrographic analysis is used by them as one of many tools. The frequency of analysis can be important, and results can only be based on experience. The user should be careful in interpreting results since so many variables are involved.

Questions were asked about costs, and it turned out that single analyses varied from $11 to $65 depending largely on the amount of overhead charged to them. L. F. Deming, Mem. ASME, stated that the U. S. Navy Bureau of Yards and Docks is building an outfit for both spectrographic and chemical-sulfur analyses for less than $2500.

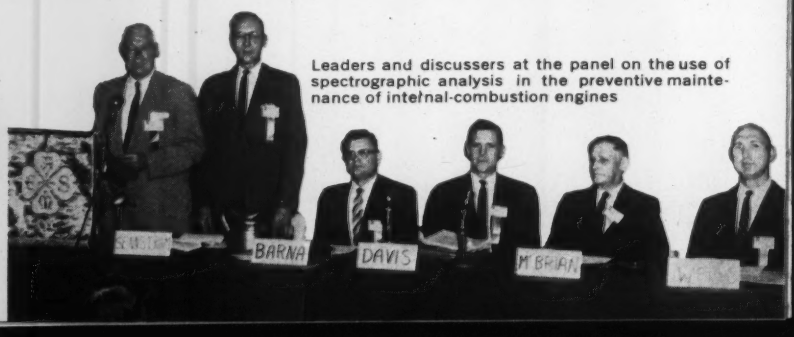
What's New?

A year ago, J. E. Onnan, chairman of the OGP exhibits committee, introduced a "What's New" session in which each exhibitor gets three minutes "eggsactly" (a three-minute sand-type egg timer is used) to tell what's new in his company's products. One participant, in a twist on a popular television program title, suggested that the session should be called "This Is My Line."

This year, 19 took to the platform to utilize this means of tying exhibits and conference more closely together. What's new?: *Nordberg*, a turbocharged $21\frac{1}{2}$-in. 2-cycle engine with increased power per cylinder and fuel economy . . . *American Bosch*, a pump that has been reduced to only 110 parts, where two models back it had 450 . . . *American Air Filter*, oil-bath cleaning for a number of applications . . . *Nugent*, the refinement of "magnetic trapping" has been added to filters to catch the fine ferrous particles that pass through . . . *Vanderhorst*, new methods that simplify the seating of rings . . . *Koppers*, industrial cooling fans with more cfm per hp . . . *Power-Plus*, a slow-flow recording meter for 2 to 40 lb inlet pressures . . . *Robertshaw-Fulton*, pneumatically actuated control systems for high-hp installations where complete dependability is important . . . *Engineering Controls*, sea-water distillation at 30 gal per hr by exhaust-heat recovery from diesels . . . *Bendix Scintilla*, S-500 low-tension magneto industrial ignition systems incorporating the retard-breaker and starting vibrator . . . *Diamond Chain*, new chain ratings, under industry sponsorship, reflecting increases in hp ratings and speeds of up to 100 per cent . . . *C. Lee Cook Company*, new specialized test equipment that is permitting tailored and improved piston-ring products . . . *North Electric*, remote controls for everything from Dew-Line radar stations to nuclear applications . . . *Illinois Testing*, pyrometer metering to tell a truck driver when to shift gears up or down . . . *Hilliard*, 20 different types of filters, including one capable of filtering down to $\frac{1}{2}$ to 1 micron . . . *Fairbanks Morse*, a new high (1920 hp) in packaged equipment for stationary opposed-piston $8\frac{1}{6}$ × 10 engines for diesel, dual-fuel, or spark ignition . . . *Dow Chemical*, Dowtherm 209 for freeze protection to −45 F in stationary vapor-cooled engines . . .



L. A. Platt, **left**, chairman, K. C. Section, delivered the Welcome Address, and Harold Grasse, Vice-President, ASME Region VIII, was m. c. at the opening luncheon



Leaders and discussers at the panel on the use of spectrographic analysis in the preventive maintenance of internal-combustion engines

Scintilla Division of Bendix booth at the Oil and Gas Power Show displayed some of the items presently being developed and some still on the drawing board with a promising potential . . . interesting information and a good place to rest weary feet

Honors: **left to right,** W. C. Fischer, Emil Grieshaver, received citations for outstanding service; Walker L. Cisler, ASME President, who congratulated the honorees; and W. S. Quimby who received a special lecture award

Motor-Pak, a positive-displacement, air-operated lubrication device for accurate, repeatable, small-quantity lubricant injection . . . *Taylor Forge*, acquisition of the Metal Products Division of Fluor Corporation which will add industrial mufflers, gas cleaners, and pulsation dampers to the company's products . . . *Woodward Governor*, a load-sensing electronic governor with a good mechanical governor for backup.

Luncheon and Banquet

Harold Grasse, Vice-President of ASME Region VIII, and partner, Black & Veatch, Kansas City, Mo., was master of ceremonies at the Welcome Luncheon. L. A. Platt, chairman of the ASME Kansas City Section, Gordon Johnson Company, Kansas City, Mo., extended the welcome to those attending the conference. The first prize winners for Student Papers, and their faculty advisers, from each of the three Regional Student Conferences in Region VIII were honored at the luncheon.

ASME President Walker L. Cisler, president of the Detroit Edison Company, delivered the banquet address on "The Human Side of Energy and Fuel." Emphasizing again the universal importance of power in improving the various national economies of the world, he spoke of the part that the engineer has in this vital field.

He stated that engineers everywhere understand the importance of energy sources and that even in Russia there appears to be sentiment for the peaceful application of nuclear power and the constructive use of electrical energy.

Speaking shortly after Khrushchev had brought about the end of the summit conference, Mr. Cisler reminded his audience that the man most likely to succeed Khrushchev was an engineer.

John C. Gibb, chairman of the ASME Oil and Gas Power Division, presided, and Eugene L. Miller, president of the Diesel Engine Manufacturers Association, and president of the Cooper-Bessemer Corporation, was toastmaster.

Citations for outstanding service were presented to Emil Grieshaber, Mem. ASME, who for many years was chief engineer of the Nordberg Manufacturing Company, and to John A. Worthington, Fellow ASME, manager, Piston Ring and Seal Department, Metal Products Division, Koppers Company, Inc.

OGP Speakers Awards were presented to C. M. Floyd and E. D. Shannon of Humble Oil and Refining Company for their paper, "Field Study of Gas Engine Lubricants, Part 2"; to W. C. Fischer, Mem. ASME, Fairbanks Morse & Company, for his paper on "Production Design of a Modern, Axial-Flow, Positive-Displacement Rotary Compressor." A Special Lecture Award went to W. S. Quimby, Texaco, Inc., for "Automation in the Gas and Oil Industry."

Inspection Trip

TWA's International Overhaul Base at Kansas City was inspected by two busloads of mechanical engineers. Every TWA engine is overhauled here with the frequency required by FAA regulations, and complete overhauls are made of the entire plane at other intervals. The $25-million maintenance center is uniquely constructed to allow for changing wing spans. There are no posts, columns, or other obstructions in the two 816-ft-long by 160-ft-wide hangars which are on either side of the central 1000-ft-long office portion of the building.

The hangar roofs are cable-supported from a series of huge beams which project above the roof of the central portion. The two upper floors of the office portion are also hung from these beams.

Incidentally, the tornado mentioned earlier never arrived and those Hereford steaks are good.

An availability list of papers presented at this meeting follows. Digests of all papers which are not scheduled for publication in MECHANICAL ENGINEERING will appear in the "ASME Technical Digest" in this or a forthcoming issue of MECHANICAL ENGINEERING.

Availability List—Oil and Gas Power Conference

THE papers in this list are available in separate copy form until March 1, 1961. Please order only by paper number; otherwise the order will be returned. Copies of these papers may be obtained from the ASME Order Department, 29 West 39th Street, New York 18, N. Y. Papers are priced at 40 cents each to members; 80 cents to nonmembers. Payment may be made by check, U. S. postage stamps, free coupons distributed annually to members, or coupons which may be purchased from the Society. Coupons, in lots of ten, are $3 to members; $6 to nonmembers.

60—OGP-1 Internal-Combustion Engines in Steam Power Stations, by G. C. Boyer

60—OGP-2 Cost Comparisons—Diesel and Steam, by S. K. Fosholt

60—OGP-3 Horsepower to Heat the Nation, by R. S. Jefferies

60—OGP-4 Development of a Speed and Load-Sensing Governor, by G. W. Taylor

60—OGP-5 Application and Range of the Tuned Housing Vibration Damper, by E. A. Moorehead

60—OGP-6 Piston-Ring Design and Application Practice for Modern Large-Bore Diesel and Gas Engines, by F. A. Robbins and J. W. Lippert

60—OGP-7 Design and Development of Turbochargers for the General Motors Corporation Series 567 Engines, by A. N. Addie

60—OGP-8 A Laboratory Gas Engine Lubricant Study, by P. M. Coant and L. W. Manley

60—OGP-9 Nozzle Design Cuts Locomotive Costs, by W. J. Gewinner

60—OGP-10 System Stability Analysis Including Governor, Engine, Generator, and Tie-Line Impedance, by L. D. Brinson, G. Parker, and F. S. Rothe

60—OGP-11 Economics of Engine Power Development of the Alco 251 Engine, by P. S. Vaughan

60—OGP-12 Power Cost Studies for Systems With Diesel Generating Stations, by W. H. Reed

60—OGP-13 Some Experimental Results From a Two-Cycle Diesel Engine Exhaust Waste-Heat Exchanger, by J. C. Georgian

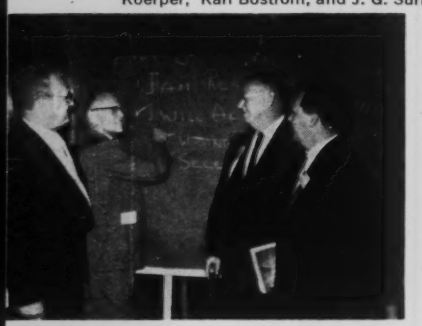
Superiority in PRODUCTION, Not Rockets, Will Make the Difference, Says Hahn at Production Engineering Conference in Milwaukee

Registration, Tickets, Papers, etc., all at one desk make the Conference easy going

Banquet Night and the meeting takes on a gala sparkle. Ben G. Elliott, Fellow ASME, **left,** and J. L. Singleton, Mem. ASME, Banquet speaker, get the cues arranged

T. J. Dolan, ASME Vice-President, Region VI, **left,** and R. S. Hahn, Product Engineering Division Chairman, check Session 5 details

Back to the board to make a point at the first session, **left to right,** L. C. Lander, Jr.; E. C. Koerper; Karl Bostrom; and J. G. Surmacz



AMONG the cities of the United States, Milwaukee, Wis., stands eighth in industrial production. The city's industrial leaders rate a place near the top in the quality of their thinking on the problems facing American industry. These are problems both of mechanism and management.

Milwaukee has just been host to the National Production Engineering Conference of The American Society of Mechanical Engineers, held May 17–19, 1960. More than 270 engineers met in the "gathering place by the waters" to discuss the design and operation of metalworking machinery, with emphasis on operation. The conference was sponsored by the Production Engineering Division of ASME, with the co-operation of the Society's Milwaukee Section, and the American Society of Tool and Manufacturing Engineers Milwaukee Chapter, and the Milwaukee Society of Production and Methods Engineers. The meeting place: Milwaukee's Schroeder Hotel.

Robert S. Hahn of Heald Machine Company, Worcester, Mass., chairman of ASME's Production Engineering Division, stated the point which was in the mind of every engineer at the conference: "The contest between the East and the West will be won in the productivity field, not with rockets." Anybody who thinks the West holds all the cards in the productivity game should have attended the technical sessions and social gatherings at this conference.

General Electric's James F. Young, Mem. ASME, newly appointed to the management of his company's Electric Utility Systems Operation, presented a film he had obtained through contacts in Japan. It was a documentary, entitled "Toshiba in Progress," revealing the facilities, craftsmanship, and products of the Tokyo-Shibura Company which, in its own way, parallels General Electric. The film is such as to put an end to complacency about our production supremacy. Parenthetically, it should also end complacency regarding our documentary motion pictures.

The impact of the Japanese film can be judged by the remark made by J. F. Fowler of the Falk Corporation, Milwaukee, who said, "You don't buy machines: You prepay manufacturing expense. The question is how far you want to prepay manufacturing expense." And then he added, "The Japanese are obviously prepaying a lot of it, as you saw in that film. They're going in for automation quite thoroughly."

We Must Produce

The opening session received the full impact of management's concern over our productive capabilities. The two papers available in preprint form were those by Karl Bostrom and G. D. Smith. Mr. Bostrom's paper will later be published in condensed form in MECHANICAL ENGINEERING. The other two presentations were the Japanese film and a paper by J. G. Surmacz entitled "Total Productivity — Motivation and Calibration."

Mr. Surmacz is plant manager of the Harnischfeger Corporation of Milwaukee, and his paper included one statement that aroused quick response: "Contempt breeds contempt." It is his belief that lack of respect between management and labor is at the root of many of our production failures. Productivity must be considered as a whole structure, not just a piece.

The subject matter of that first session naturally drew lively participation by discussers. One interesting observation was that we need to clear up the present confusion as to the evaluation of the worker's contribution: Is he being paid for the quantity he produces, or for the effort and thought he puts in—for his input or his output? If he is valued only for his output, what happens when technical developments make it possible for him to turn out twice as much? The psychology of the worker—his "motivation"—long taken for granted, is coming in for restudy.

The second technical session moved to the other end of the spectrum, presenting reviews of the past year's technical literature on the topics of metal cutting, plastic working, grinding, and fluids for cutting. These reports will be published later, in condensed form, in MECHANICAL ENGINEERING.

All this in a city which is known as the "heart city of America's dairyland" and the "brewing capital of the world." But Milwaukee is essentially a producer of hard goods. Its leading industry is the manufacture of equipment for generating, transmitting, and distributing electric power. The people of this now ocean seaport are surely not surprised at anything. Here, in a part of the country where timber was once so dense that "a squirrel could travel a thousand miles without touching ground," leading engineers now stand before microphones and analyze the USSR's ability to produce standardized tools by production-line methods.

Who Will Build the World's Machine Tools?

At the Productivity Luncheon, on the second day of the conference, Seymour Melman, associate professor in the Department of Industrial and Management Engineering, Columbia University, spoke on the problems of productivity of the machinery-producing industries. The young economist emphasized that somebody is going to sell machine tools to the awakening countries in the far places of the world. Will those countries end up using American machines?

Professor Melman has recently toured the USSR, studying their machine tools and the methods they use in manufacturing them. The Russians have standardized their machine components and are turning out tools on production lines of high efficiency. They can do this, partly because of their system, and partly because they have ahead of them an almost endless market, in their own country and in Red China.

We, on the other hand, have some 350 manufacturers turning out tools, with little standardization, and with no manufacturer able to be sure of his future market. An American company hates to put all its eggs in one basket. Professor Melman named two of our producers who are able to justify a sequential layout of manufacturing operations—and those two are able to compete in the markets of the world. For the rest, it is essentially job-shop.

"The U. S.," he said, "has about 2.2 million metalworking machines. The annual market should be about 250,000. But that is greater than recent production. It appears we have not been able to justify the price of these tools."

Professor Melman documented his points with figures and with photographs of Russian production lines. It is his belief that the reorganization of our machine-tool industry is essential to the West, that we must reduce our prices of machine tools by 50 per cent.

A happy moment at this luncheon was the presentation to Dr. Jesse W. Huckert of his certificate as a Fellow of ASME. Dr. Huckert, now Associate Editor of *Machine Design*, has performed outstanding services as an engineer, teacher, and editor. He is a specialist in gear design.

Numerical Control

The conference also heard papers on numerical control which promises to do much to bring up efficiency and reduce costs.

Later, in another session, the conference heard a paper by Miroslav Sadowy of Marquette University, which reviewed studies in rigidity and stability, bringing into English a great deal of material hitherto available only in German.

The Speaker's Table

At the banquet, the m.c. was Ben G. Elliott, Fellow ASME, former Vice-President of the Society (1952–1956), and retired professor of mechanical engineering of the College of Engineering, University of Wisconsin. Dr. Elliott presided with high good humor, a happy change from the heavy atmosphere of the technical sessions. He introduced the principal speaker, Joseph L. Singleton, Mem. ASME, and vice-president, Industries Group, of the Allis-Chalmers Manufacturing Company, who took a hardheaded view of the international race for production.

Mr. Singleton also has toured Russia, but he saw it in terms of raw materials, electric power, and problems of over-all output. He saw the difficulties that face the leaders of the USSR. Raw materials? Yes; but they're way off in Siberia and the transportation is totally inadequate. Construction? Yes; but there is an obvious shortage of cement. As Mr. Singleton viewed it, they may "bury" us, but not in this decade, not if we work together.

For example: While "they are building lathes the way we build automobiles," they need them all at home.

"While the underdeveloped, uncommitted nations need capital goods," he said, "if Russia is to develop her own industries, then she cannot export sizable amounts of capital goods."

He believes that what we can and must do is stay ahead in our engineering applications of the new scientific developments. The pressure is terrific, and many developments that would normally take years to become practical hardware must be telescoped into a shorter schedule.

"We have a crisis," he said, "and we as a nation have met other crises, like Pearl Harbor. We have done it by uniting. . . The material advantages are all on our side. The only weak link is in individuals who are continually selling short themselves, their colleagues, and our country."

Extracurricular

One doesn't go to Milwaukee and fail to drink beer. It isn't done. On the first night of the conference, the assembled engineers were guests of two breweries—Pabst and Miller—both providing professional entertainment in a rathskeller atmosphere.

After the final session, the conferees had their choice of field trips—to Kearney & Trecker (Numerical Control Division) or Allis-Chalmers (all the way from the pattern shop to a lathe for 200-ton shafts).

Altogether, it was a conference made significant as much by the headlines as by its technical content. In the words of Chairman Hahn, we "aired the problem, spelled it out."

Next year's Production Engineering Conference will be held in Toronto, Ont., Canada, May 8–10, 1961, in conjunction with the National Industrial Production Show of Canada.

Availability List—Production Engineering Conference: Papers Available

THE papers in this list are available in separate copy form until March 1, 1961. Please order only by paper number; otherwise the order will be returned. Copies of these papers may be obtained from the ASME Order Department, 29 West 39th Street, New York 18, N. Y. Papers are priced at 40 cents each to members; 80 cents to nonmembers. Payment may be made by check, U. S. postage stamps, free coupons distributed annually to members, or coupons which may be purchased from the Society. Coupons, in lots of ten, are $3 to members; $6 to nonmembers.

60—Prod-1 On the Mechanics of Shear-Spinning, by Serope Kalpakcioglu

60—Prod-2 Free Machining Steel; Part 1, Tool-Life Characteristics of Resulfurized Steel, by M. C. Shaw, P. A. Smith, and N. H. Cook

60—Prod-3 A New Test Method for Determination of Spinnability of Metals, by R. L. Kegg

60—Prod-4 Free Machining Steel; Part 2, Tool-Life Characteristics of Leaded Steel, by M. C. Shaw, P. A. Smith, and N. H. Cook

60—Prod-5 A Milling Torquemeter of Planetary-Gear Design, by J. R. Roubik

60—Prod-6 The Simultaneous Development of Machinery and Tools, R. K. Sedgwick

60—Prod-7 On the Analysis of Random Errors in Precision Grinding Operations, by R. S. Hahn

60—Prod-8 Machinability of Nodular Cast Irons; Part 1, Tool Forces and Flank Adhesion, by Inyong Ham, Katsundo Hitomi, and G. L. Thuering

60—Prod-9 Mathematical Models for Analysis of Job-Shop Capital Equipment, by J. F. Fowler

60—Prod-10 Three-Axis Numerical Control of Precision Boring Machine, by C. R. Hibbard

60—Prod-1 Factory Management and Labor Controls, by G. D. Wolfe

60—Prod-12 1959 Review of Literature on Metal-Cutting Analysis, by J. S. Campbell, S. Kobayashi, J. M. Galimberti, R. S. Hahn, and E. G. Thomsen

60—Prod-13 1959 Review of Literature on Plastic Working of Metals, by F. W. Boulger

60—Prod-14 1959 Review of Literature on Grinding, by G. S. Reichenbach

60—Prod-15 1959 Review of Literature on Cutting Fluids, by P. A. Smith, E. L. H. Bastian, and C. A. Sluhan

60—Prod-16 Productivity—The Great Commitment, by Karl Bostrom

60—Prod-17 Some Physiological Effects of Low-Frequency, High-Amplitude Vibration, by M. A. Schmitz and C. A. Boettcher

60—Prod-18 Rigidity and Stability of Machine Tools, by Miroslav Sadowy

ASME Design Engineering Conference . . .

Hundreds of Engineers Gather in New York Coliseum, May 23–26, to Air Design Problems and Developments

SPICED with a strong flavor of nuclear and space technology and techniques, the 1960 ASME Design Engineering Conference opened at the New York Coliseum, May 23, with a panel of leading authorities discussing new horizons in engineering design, and continued in seven subsequent technical sessions to demonstrate how new design principles have influenced long-familiar and novel consumer and industrial products.

Some 1400 engineers participated in open forums and asked thousands of questions on the latest advances in the design field. This "probing" is a major ingredient of the Conference: What is done with the answers undoubtedly will be revealed in future commercial designs and laboratory and manufacturing techniques.

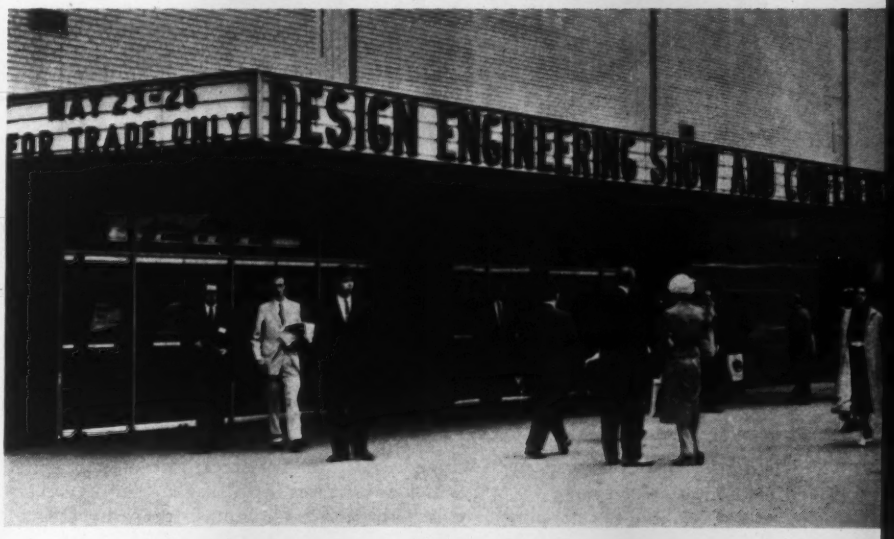
The topics covered in the formal technical sessions following the opening panel included reliability prediction and requirements in equipment specification; new developments in joining and forming metal parts; hydraulic components to meet the requirements of extreme pressures and temperatures; design of control systems; high-strength materials; and automation; and concluded with a general engineering panel on where and how to use computers.

Digests of the technical session papers, of which there were 12, appear in the May, 1960, issue of MECHANICAL ENGINEERING, pp. 144–146. (See also the Availability List on page 104 of this issue.)

. . . and Design Engineering Show

From May 23 through 26, 1960, the Design Engineering Show was held at the New York Coliseum. The Show, produced by Clapp & Poliak, Inc., of New York City, utilized four floors of the enormous building and was viewed by 22,500 visitors from some 20 countries. At an estimated value of $10 million, 430 companies exhibited 10,000 products. This, the fifth annual concurrent show and conference, was the largest in the series. It was about 15 per cent larger than the 1959 show which was held in Philadelphia, Pa. The 1960 attendance set an all-time record for the exposition. The 1961 show will be held at Cobo Hall, Detroit, Mich., May 22 to 25.

New Horizons in Engineering Design



The ASME Design Engineering Conference opened on Monday morning with a panel of authorities who appraised advances and projected planning into future avenues of exploration—new horizons in design engineering.

Arthur R. Kantrowitz, director of Avco-Everett Research Laboratory, Everett, Mass., stated that all the elements now exist for life in outer space. It "will come when enough research and engineering have been done and when space is required for human social use," he said.

Dr. Kantrowitz criticized scientists and engineers who, he said, "are too conservative about seeing the possibilities of scientific advances.

"In centuries past, when America was discovered, scientists thought of it as an extension of geography. Today, some of us look to space as an extension of the science of astronomy. It is much more than that. Space is for people. Outer space is simply an extension of life on earth," said he.

"Energy for living in space is available from nuclear and solar sources. It is difficult to find any scientific law that will be violated in the prospects of people living out there. Not on planets, for they are unsuitable, but living in contained areas, transported and built, piece by piece, just as a building is constructed by transporting components to a selected site."

Hugh L. Dryden, Fellow ASME, Deputy Administrator of the National Aeronautics and Space Administration, declared that "the development of supersonic, commercial aircraft requires government support.

"It is improbable that supersonic transport planes will evolve from military developments because the hundreds of millions of dollars required to design, test, and build them are beyond the means of the aircraft industry," said Dr. Dryden. "But there is persistent pressure for civilian transport planes which will travel 2000 to 3000 mph."

Elmer P. Wheaton, vice-president—technical, of space and missiles systems for the Douglas Aircraft Company, Santa Monica, Calif., pointed out we are rapidly approaching the time when "all the knowledge of the world will be at a man's fingertips."

"Retrievable data offer high promise for mankind," he said. "The problem is to make knowledge accessible for use when needed. New methods and electronic computers, developed almost by necessity in this age of nuclear physics and space, make it possible systematically to store data and to call forth at will all previous records of experience to assist man in exercising judgment."

Thus far, nuclear technology has scored an impressive array of new products, William R. Gall, Mem. ASME, Reactor Experimental Engineering Division, Oak Ridge National Laboratories, told the audience. Outstanding are: Submarines, central power stations, and, most recently, rocket power plants which are now undergoing preliminary tests.

Among techniques developed for nuclear reactors which may have wider application is the use of canned motor pumps.

Mr. Gall predicted that special lubricants for the high-temperature environment of the reactor also will find wide application.

A full-scale nuclear power plant on Antarctica is economically feasible, said Varick D. Schwartz, Assoc. Mem. ASME, assistant project manager of the Army Boiling Water Reactor Project now in progress at Combustion Engineering, Inc., Windsor, Conn.

Mr. Schwartz said an extension of a prototype plant now operating in Connecticut can be installed "any time there is a will to do it and funds become available."

Within five to ten years, the technological achievements of satellite navigation and communication will become commonplace in commercial fields, predicted Arthur L. Shef, chief of space technology for the Institute of Defense Analysis (a group advising the government on technical problems). Components in the process of development are certain to have application in radio equipment and in new materials. However, Mr. Shef warned that in a few decades his present list doubtless will seem trivial. Mr. Shef stated that the satellite program will depend heavily upon new structural materials of super strength, resistant to radiation and high temperatures.

ASME booth at Design Engineering Show reflects the Society's role in the field of machine design, product engineering, and use of engineering materials

Some 400 companies exhibited the latest fruits of their research and development programs at the N. Y. Coliseum, May 23–May 26, during the Design Engineering Show. And some 22,500 engineers were on hand to look, witness actual demonstrations, pick up samples, and, most important, to ask questions. Here are a few of the things they saw:

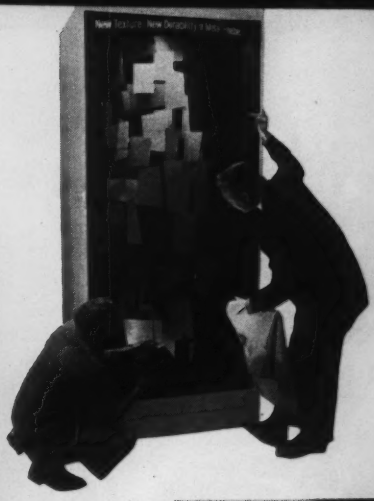
A 50,000,000 lumen light-flasher, one of the most powerful light sources on earth, for tracking rockets when they are shot off into space (Battelle) . . . Bearings which will soon make possible home appliances which never need oiling; furnaces which don't rumble; air conditioners which won't squeak; kitchen fans that won't leak oil (Tann/Bearing Co.) . . . Machine shafts that float on air, instead of oil (Amplex Div., Chrysler) . . . A picnic cooler which weighs less than a pound but holds 40 lb of ice (H. B. Fuller Co.) . . . Tiny electric batteries less than an inch long (Lead Industries) . . . New adhesives capable of supporting 5000 psi (Eastman Chemical) . . . All sorts of basic materials: Rubber which substitutes for steel; aluminum which substitutes for plastic; wood which substitutes for oil; glass which substitutes for aluminum; plastics which substitute for almost anything. There were also the new wonder metals including molybdenum which can now be heated to 2400 F . . . Coated glass to stop fluorescent lamps from interfering with radio and television reception (Corning Glass) . . . Plastic missile pads which won't harden even at near absolute zero temperature and won't soften at 300 F (Enfab) . . . Even a sportsman's rifle with the barrel made of glass.

Binks Manufacturing Company booth draws large crowd. The company makes complete spray finishing systems.

Design Engineering Show Exhibits

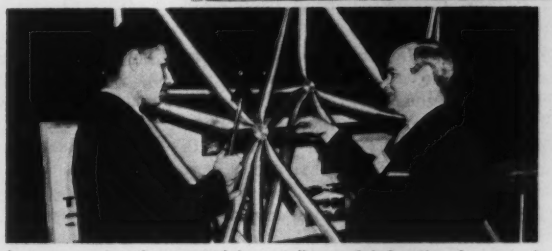
. . . Including

Norman Forsythe, Bendix Aviation Corporation, engineer, **right,** explains operation of computer which can write engineering books to Kenneth E. Knowles, managing director of show. The completed pages need neither editing nor typesetting and are ready for printing by photo-offset process.



This color "tree" is designed to show color and texture versatility, offered by Metal & Thermit Corporation's recently announced spray-applied vinyl finishes for steel and aluminum

Visitors at Acro Division—Robertshaw-Fulton Controls Company booth

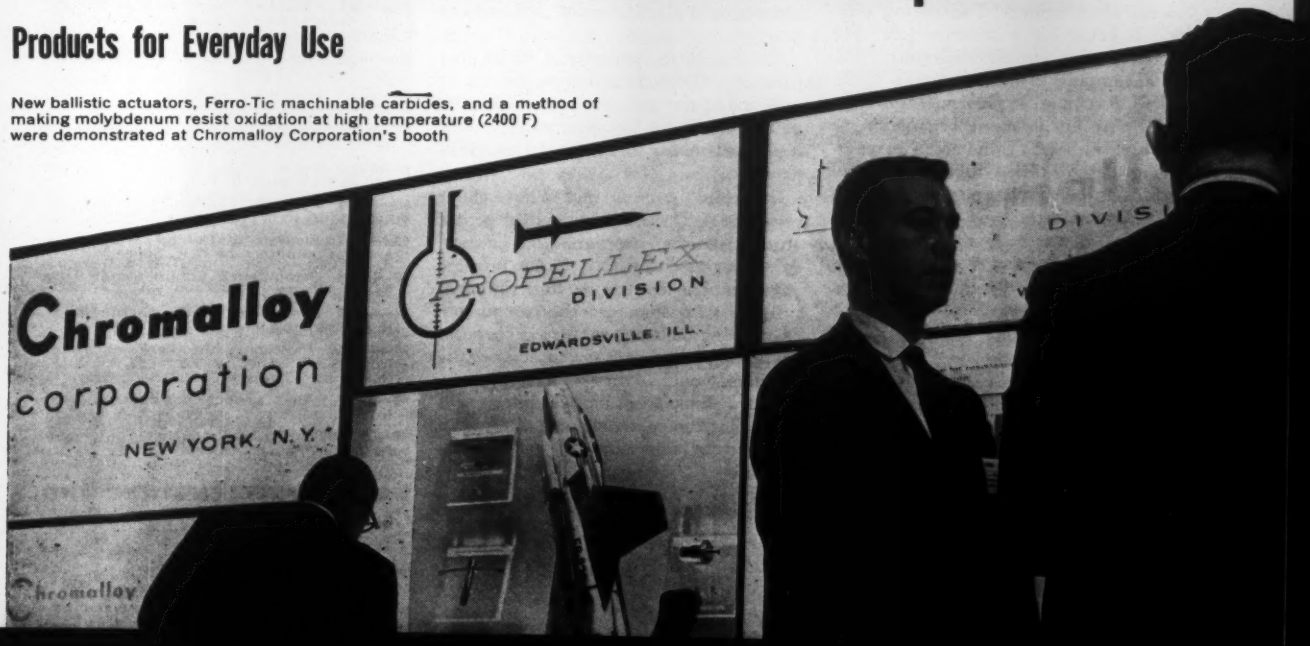


A new construction material—equally useful for the frames of buildings, radar screens, boat docks, and household furniture—was featured at Canadian exhibit. Made of aluminum tubing, the material is assembled by inserting the tube ends into a slotted hub, without bolting, riveting, or welding.

Feature Scientific and Technical Developments...

Products for Everyday Use

New ballistic actuators, Ferro-Tic machinable carbides, and a method of making molybdenum resist oxidation at high temperature (2400 F) were demonstrated at Chromalloy Corporation's booth



Use of Computers in Design Engineering

On the morning of the last day of the conference—Thursday, May 26—the technical session was built around a panel of computer users who have had the problems of scheduling and integrating their computers into an over-all setup.

E. F. Magnusson of General Electric led off. He spoke of the past of computers, which isn't much—a matter of ten years. He recalled that they "were talking about it" at M.I.T. in 1947. First came the analog computer, which took care of differential equations, followed later by the digital computer, which deals out choices and decisions, giving them to you in printed form. The mere solving of equations leaves a lot up in the air.

Mr. Magnusson followed through with a discussion of the factors that enter into the choice of a computer. What size? How much total effort will be required?

Some observations: The analog computer is better for a one-shot job. For repetitive work, choose the digital. The digital computer is more accurate.

G. F. Ryckman of General Motors reported that his company began using a computer in 1952. The needs of engineering design called for the original machine to be supplemented by an IBM 701, followed later by a 704. By that time, the 701 was being run three shifts, around the clock—and weekends.

Aaron Finerman of Republic Aviation took up the matter of costs.

1 Doing calculations manually and by desk calculators	$2.40	per hr
Engineers	5.00	" "
2 The computer	240.00	" "
Programmers	5.00	" "

The machine will do in 0.01 sec what the desk man will do in ten minutes.

Where does the computer excel? First, when you have a simple problem but a tremendous number of cases. Then, at the other extreme, you go to the computer with a complex problem that manual calculation couldn't solve in years. Example: An interplanetary trajectory—a time history of a vehicle to reach an objective like Venus. Differential equations describe the motion of the vehicle under various gravities. You'd need five years just to solve one case.

With the computer, you'll need $1\frac{1}{2}$ man years to program the trajectory: Then 50 computer hours to check out the setup. Then 20 min for each case—on a 704 computer. For such tremendous undertakings you don't argue about the computer. There's no choice. In fact, computing and engineering research go together.

Mr. Finerman estimated it would cost from $95,000 to $160,000 per month to own and operate a big computer ($50,000 to $80,000 is for the equipment). But more and more, the computer is indispensable.

Questions poured in. What about personnel? There are few skilled people around, and they command high salaries. A recent graduate with only two or three years' experience may be your top man.

As to who shall use the computer—engineering or finance—there is no problem until you get near the capacity of the machine, and computer-time becomes critical. Even then, most engineers will agree that the payroll should come first. Where trouble develops is where one department controls the computer. Perhaps it should be controlled by a separate department.

Design Engineering Conference Availability List

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60—MD-1 Reliability Prediction—Its Validity and Application as a Design Tool, by T. C. Reeves

60—MD-2 The Impact of Reliability on Design, by H. R. Powell

60—MD-3 New Welding Processes, by J. J. Chyle

60—MD-4 Metal Fabrication by Explosives, by Vasil Philipchuk

60—MD-5 Current Status of Hydraulic Pumps and Some Trends, by E. I. Brown

60—MD-6 Hydraulic Fluids—Today and Tomorrow, by R. L. Leslie

60—MD-7 Analysis of Control Systems by Analog Computers, by W. E. Sollecito

60—MD-8 Computers in Control Systems, by A. S. Robinson

60—MD-9 Some Considerations in the Use of High-Strength Steels, by A. M. Hall

60—MD-10 Increasing the Performance of Nonmetallic Structural Materials, by W. E. Dirkes

60—MD-11 The Concept of Modular Design for Mechanized Assembly, by A. A. Lawson

60—MD-12 Designing Products for Automatic Assembly, by R. L. Esken

"Design for Motivation," Says J. E. Trainer in Address Before Akron Section

MECHANICAL ENGINEERS were given an unusual design assignment when they were told to "Design for Motivation" in a talk of that title by J. E. Trainer, Fellow ASME, executive vice-president of the Firestone Tire and Rubber Company, at a recent meeting of the Akron Section of The American Society of Mechanical Engineers.

He emphasized that the interactions involved as one man works with his fellow men are vital to the whole business, social, and political structure.

Mr. Trainer stated that although design for motivation sounds complicated and intellectual, it really isn't. Motivation is any idea, need, emotion, or state that prompts an individual to action.

Narrowing his topic to the goal of motivating persons to learn, appreciate, and champion the benefits and the values of the free-enterprise system, he asked, "Who will do this job?"

There is a very mysterious group, he stated, that has invaded our American society. Although widely sought, these people have never been seen. The group is known as "They." Around the lunch tables, over cocktails, in office gab sessions, at the coffee machine, in family councils, everywhere, it is heard that *they* ought to do something about that, *they* should correct this undesirable situation, *they* ought to increase this, *they* ought to decrease that. But, *they* simply cannot be identified. No one confesses to being *they*. Few persons are willing to take the bitter pill of responsibility.

In the best-selling book, "The Man in the Gray Flannel Suit," there was a character named Tom Rath. Tom, who had returned from World War II, was applying for a position with United Broadcasting Company. In filling out a questionnaire he was asked to complete this sentence, "The most important thing about me is . . ." How would you answer that question?

Your design for human relations should be the most important thing about you. You might complete the sentence by saying, "The most important thing about me is that I seek, through my work and my contacts, to leave my part of the world better than I found it."

Stating that each individual depends on every other individual and that overall teamwork is necessary, Mr. Trainer emphasized that it must be remembered that it all starts with you.

The English philosopher, Herbert Spencer, said: "I am constantly impressed with how infinitesimal is anything that I can do; yet I am even more impressed with how important it is that I do it."

The Modern Barbarian. Would you consider yourself a barbarian? Do you think of a barbarian as a prehistoric individual? There are barbarians today in almost every office. A Spanish philosopher defines a barbarian as the mass man, the self-satisfied man. He explains that the primitive barbarian wandered in the forest, took his food and shelter there, and felt no responsibility for them. Nature endowed him, nature owed it to him. In the same way, the modern barbarian accepts as his natural gift and due all the wonderful achievements of his own civilization.

He rides an elevator; he drives his car; he is protected from fire, disease, and theft. He accepts the benefits of democracy, the wages of free enterprise, the proceeds from modern machines and tools. He takes all the privileges, the opportunities, the freedoms, and feels no responsibility to the society and the economy that has made them possible. How barbaric are you?

Take a good look at what we have in America. No nation on earth ever gave so much to so many—so much liberty and so much prosperity as the American constitutional form of government. Should it be necessary to sell this gift to the receivers? Surely there are difficulties in a democracy, and bad ones, but they can be solved. First, it is necessary to know the facts, to be economically intelligent. Then you should be willing to take a share of the responsibility, and begin to act.

Motivating Through Good Human Relations. We motivate through good human relations. Good relations require study—learning about persons, their reactions, their needs, their desires. In the process of study, indulge in considerable self-evaluation. Appraise your own capabilities very objectively and learn how to change when change is indicated. You cannot be a leader if you refuse to accept yourself at your real value.

Good relations demand sacrifice. You must be willing to give and to take. You may find it necessary to give up that old pet idea. You may be required to sacrifice personal gain for the common good. You are going to find it necessary to get off the comfortable couch of Personal Gain and sit often in the straight chair of Responsibility.

Good relations call for respect—respect for the rights and privileges of others, respect for their opinions, and respect for their ability to make important contributions to the total effort.

Good human relations require acceptance. People and facts must be accepted as they are. Existing circumstances cannot be denied. They will not go away by ignoring them. Once you accept conditions honestly, you are on the way to a solution.

Basic Engineering Design. As you begin this design for motivation, you need to recall some of your knowledge of basic engineering design:

1 You must design for the whole system. One part perfectly designed and assembled into a whole machine in which this perfect part is the only satisfactory part is wasted and overdesigned.

It is vital to recall that the "whole man comes to work." The physical man, the mental man, the spiritual man, the man with domestic problems, the man with financial worries, with the pride of his successes, the joys of his family. He should be treated as a whole man.

We need to learn how to utilize the whole man. His hands have been emphasized too long. Design to get his heart, his brains, his eyes, his ears, his mouth. Design to utilize the whole man.

2 Design with tolerance. Any engineer knows the value of tolerance. A rigid structure like a skyscraper, an airplane, and many other structures must allow for "give," for flexibility. The inflexible structure cannot go with the wind, relax with the ebb and flow. Design with tolerance.

3 Design to reduce friction. There will be many drag forces, many delays. Proper design will reduce friction by allowing for it and building in compensations. Lubricating devices to insure good operation are desirable.

4 Finally, design with the expectation of success. Emphasize the positive. What you are for, is much more important than what you are against.

If you have designed well, you will motivate persons and yourself to utilize the means available to the maximum.

If the people you work with are motivated through good human relations, they will work productively, with cooperation, and with economic, social, and mental satisfaction, and you will have had a great part in the design, or redesign shall we say, of that great invention, a more perfect union.

Joint Automatic Control Conference at M.I.T., Sept. 7–9, 1960

DESIGNED to reduce the overlap of conferences on control, sponsored by individual societies, the annual Joint Automatic Control Conference provides a unique high-level conference on the theory and application of automatic control. This year's meeting to be held September 7–9, in Kresge Auditorium, at the Massachusetts Institute of Technology, Cambridge, Mass., is sponsored by The American Society of Mechanical Engineers, with the co-operation of the Boston Section, and the participating societies, Institute of Radio Engineers, American Institute of Electrical Engineers, Instrument Society of America, and American Institute of Chemical Engineers will conduct no other national conferences on control, except as part of their general meetings.

The technical program composed of 18 sessions will feature a report on the first IFAC Congress held in Moscow, USSR, June 20 to July 2, 1960.

▶ WEDNESDAY, SEPTEMBER 7

Optimal Switching — 9:00 a.m.

Chairman: *R. E. Kalman*, RIAS, Baltimore, Md.
Vice-Chairman: *N. H. Choksy*, Applied Physics Lab., The Johns Hopkins Univ., Silver Spring, Md.

Dynamic Synthesis of Higher Order Saturating Systems, by *F. Kurzweil, Jr.*, Gen. Products Div., San Jose, Calif. (ASME Paper No. 60—JAC-2)

Solution Space Approach to the Design of Optimal Control Systems, by *Yu-Ch-Ho*, Computation Lab., Harvard Univ., Cambridge, Mass. (ASME Paper No. 60—JAC-11)

The Optimum Response of Second-Order Zero Seeking Velocity Controlled Systems With Contactor Controls, by *I. Flugge-Lots* and *Mih Yin*, Div. of Engineering Mechanics, Stanford Univ., Stanford, Calif. (ASME Paper No. 60—JAC-3)

Pulse-Width Relay Control in Sampling Systems, by *W. L. Nelson*, Dept. of Electrical Engineering, Columbia Univ., New York, N. Y. (ASME Paper No. 60—JAC-4)

Chemical Process Dynamics — 9:00 a.m.

Chairman: *L. M. Zoss*, Valparaiso Univ., Valparaiso, Ind.
Vice-Chairman: *A. S. Foss*, E. I. du Pont de Nemours and Co., Inc., Wilmington, Del.

Survey of the Literature on Heat-Exchanger Dynamics and Control, by *T. J. Williams* and *H. J. Morris*, Monsanto Chemical Co., St. Louis, Mo. (AiChE Paper No. 1)

The Dynamics and Control of Distillation Units and Other Mass-Transfer Equipment, by *R. R. Rothfus* and *D. H. Archer*, Carnegie Inst. of Tech., Pittsburgh, Pa. (AIChE Paper No. 2)

Dynamics of Chemical Reactors, by *L. Lapidus*, Dept. of Chemical Engineering, Princeton Univ., Princeton, N. J. (AiChE Paper No. 3)

General Papers 1 — 9:00 a.m.

Chairman: *R. Knudsen*, Engineering Staff, Gen. Motors Tech. Center, Warren, Mich.
Vice-Chairman: *J. L. Harned*, senior research engineer, Research Labs., Gen. Motors Tech. Center, Warren, Mich.

Optimization of Chemical Processes, by *A. E. Hoerl* and *C. R. Hall*, E. I. du Pont de Nemours and Co., Inc., Newark, Del. (Paper No. ISA—1-60)

Accurate Pressure Regulation by Digital Servo System, by *O. K. Kowallis*, Wiancko Engineering Co., Pasadena, Calif. (Paper No. ISA—5-60)

Fractionation Control by Chromatography, by *H. J. Maier*, Perkin-Elmer Corp., Norwalk, Conn. (Paper No. ISA—7-60)

Application Factors in Transmitter Design, by *V. V. Tivy, P. H. Drinker*, and *M. C. Kessel*, Foxboro Co., Foxboro, Mass. (Paper No. ISA—8-60)

New Techniques in Control System Theory — 2:00 p.m.

Chairman: *J. E. Gibson*, Dept. of Electrical Engineering, Purdue Univ., Lafayette, Ind.
Vice-Chairman: *B. Friedland*, Dept. of Electrical Engineering, Columbia Univ., New York, N. Y.

Design of Optimum Multivariable Control Systems, by *E. B. Lee*, Military Products Group, Minneapolis-Honeywell Regulator Co., Minneapolis, Minn. (ASME Paper No. 60—JAC-5)

Reduction of Dimensionality and the Dynamic Programming Treatment of Control Processes, by *R. Bellman* and *R. Kalaba*, The RAND Corp., Santa Monica, Calif. (ASME Paper No. 60—JAC-6)

Kinetic Lypaunov Functions for Stability Analysis of Nonlinear Control Systems, by *S. S. L. Chang*, Dept. of Electrical Engineering, New York Univ., New York, N. Y. (ASME Paper No. 60—JAC-7)

New Results in Linear Filtering and Prediction Theory, by *R. E. Kalman*, RIAS, Baltimore, Md., and *R. S. Bucy*, Applied Physics Lab., The Johns Hopkins University, Silver Spring, Md. (ASME Paper No. 60—JAC-12)

Dynamic Testing of Components and Systems — 2:00 p.m.

Chairman: *J. P. Lienesch*, The Foxboro Co., Foxboro, Mass.
Vice-Chairman: *J. J. Hamrick*, Burroughs Corp., Paoli, Pa.

Basic Survey of Methods Available for Dynamic Testing of Components and Systems, by *L. A. Gould* and *R. W. Rasche*, Dept. of Electrical Engineering, M.I.T., Cambridge, Mass. (AIEE Paper No. CP—60-964)

Dynamic Testing of Industrial Systems, by *A. R. Catheron*, The Foxboro Co., Foxboro, Mass. AIEE Paper No. CP—60-965)

A Simulation Facility for the Study of Decision Making in Complex Military Systems, by *J. M. Doughty*, Cambridge Research Center, U. S. Air Force, Bedford, Mass. (AIEE Paper No. CP—60-966)

Dynamic Mechanical Measurements in Computer Systems, by *A. J. Fuimarello*, IBM, Poughkeepsie, N. Y. (AIEE Paper No. CP—60-967)

Dynamic Impedance Measurement of Electrical Contacts, by *E. S. Mathison*, IBM, Poughkeepsie, N. Y. (AIEE Paper No. CP—60-968)

General Papers 2 — 2:00 p.m.

Chairman: *J. L. Harned*, senior research engineer, Research Labs., Gen. Motors Tech. Center, Warren, Mich.

Vice-Chairman: *L. Taylor*, assistant director of research, Vickers, Inc., Detroit, Mich.

High-Temperature Pneumatics—Its Use and Control, by *J. Rivard* and *J. Pembleton*, Vickers, Inc., Detroit, Mich. (Paper No. ISA—2-60)

High-Performance Pneumatic Controllers, by *F. J. Finegan, Jr.*, Sperry Gyroscope Co., Great Neck, L. I., N. Y. (Paper No. ISA—13-60)

A New Technique for the Simulation of Transport Lags, by *R. K. Sterns*, Computer Systems, Inc., New York, N. Y. (Paper No. ISA—6-60)

Physical Implementation of Torque-Saturated, Second-Order Linear Servos With Optimum Switching Schemes, by *R. M. Howe* and *L. L. Rauch*, Univ. of Michigan, Ann Arbor, Mich. (Paper No. ISA—9-60)

▶ THURSDAY, SEPTEMBER 8

Adaptive Control — 9:00 a.m.

Chairman: *K. Goff*, chief, Simulation and Analysis Group, Leeds and Northrup Co., North Wales, Pa.
Vice-Chairman: *J. Schwartzenberg*, Simulation and Analysis Group, Leeds and Northrup Co., North Wales, Pa.

Optimalizing Control With Process-Dynamics Identification, by *P. Eykoff* and *O. J. M. Smith*, Dept. of Engineering, Univ. of California Berkeley, Calif. (IRE Paper No. 60AC—15)

An Error Criterion for Adaptive Systems, by *R. Van Wechel*, Hallamore Electronics Co., Anaheim, Calif. (IRE Paper No. 60AC—13)

Adaptive Control Through Sinusoidal Response, by *K. C. Smith*, Boeing Airplane Co., Seattle, Wash. (IRE Paper No. 60AC—14)

Selected Papers on Automatic Control — 9:00 a.m.

Chairman: *T. F. Mahoney*, section manager, Surveillance Systems Dept., Raytheon Co., Equipment Div., Sudbury, Mass.
Vice-Chairman: *R. E. Claflin, Jr.*, president, Claflin Associates, Newtonville, Mass.

Synchronous Networks, by *G. Weiss*, Polytechnic Inst. of Brooklyn, Brooklyn, N. Y. (IRE Paper No. 60AC—5)

The Application of Feedback-Control Techniques to Organizational Systems, by *R. B. Wilcox*, Missile Electronics and Controls Div., RCA, Burlington, Mass. (IRE Paper No. 60AC—6)

A Simulation Study of Semi-Automatic Air Traffic Control Systems, by *A. S. Jackson, S. Pardee*, and *H. Ottoson*, Data Processing and Controls Dept., Thompson-Ramo-Wooldridge Products Co. (IRE Paper No. 60AC—9)

Control Concepts for Nuclear Ramjet Reactors, by *R. E. Finnigan*, Univ. of California, Lawrence Radiation Lab., Livermore, Calif. (IRE Paper No. 60AC—7)

Stability and Control of Nuclear Rocket Propulsion, by *R. R. Mohler*, N-4 Group, Univ. of California, Los Alamos, N. Mex. (IRE Paper No. 60AC—8)

Control Components 1 — 9:00 a.m.

Chairman: *W. E. Sollecito*, Gen. Electric Co., Schenectady, N. Y.
Vice-Chairman: *P. Troutman*, Gen. Electric Co., Schenectady, N. Y.

PERCOS—Performance Coding System of Methods and Devices Used for Measurement and Control, by *E. Mittlemann*, consulting engineer, Chicago, Ill. (AIEE Paper No. CP—60-972)

A-C Tachometer Specifications, by *D. Bloser*, Daystrom Transicoil Co., Worchester, Pa. (AIEE Paper No. CP—60-973)

Dynamic Response Testing, by *P. S. Buckley*, E. I. du Pont de Nemours and Co., Inc., Wilmington, Del. (AIEE Paper No. CP—60-974)

Synthesis and Programming of Digital Computer Control Systems — 2:00 p.m.

Chairman: *J. R. Ragazzini*, Dean of Engineering, New York Univ., New York, N. Y.
Vice-Chairman: *A. S. Robinson*, head, Advanced Electronics Lab., Bendix Corp., Teterboro, N. J.

Control Programming—Key to the Synthesis of Efficient Digital Computer Control Systems, by *A. S. Robinson*, head, Advanced Electronics Lab., Bendix Corp., Teterboro, N. J. (AIEE Paper No. TP—60-969)

Information Handling Efficiency of a Digital Control Computer, by *H. Freeman*, Sperry Gyroscope Co., Great Neck, L. I., N. Y. (AIEE Paper No. TP—60-970)

Logical Organization of the Honeywell D-290, by *J. J. Eachus*, Datamatic Div., Minneapolis-Honeywell Regulator Co., Boston, Mass. (AIEE Paper No. TP—60-971)

Control Components 2 — 2:00 p.m.

Chairman: *A. R. Aikman*, Schlumberger Oil Well Surveying Corp., Ridgefield, Conn.

Vice-Chairman: *R. M. Howe*, Dept. of Aeronautical and Astronautical Engineering, Univ. of Michigan, Ann Arbor, Mich.

Standard Servo Package System, by *R. Spencer*, Vickers, Inc., Detroit, Mich. (Paper No. ISA—4-60)

Analysis of Electrohydraulic Valves and Systems, by *R. C. Cataldo*, Research Labs., Gen. Motors Tech. Center, Warren, Mich. (Paper No. ISA—11-60)

The Dynamics of Common Magnetically Damped Instruments, by *M. M. Gibbs*, Minneapolis-Honeywell Regulator Co., Boston Div., Boston, Mass. (Paper No. ISA—12-60)

General Papers 3 — 2:00 p.m.

Chairman: *J. L. Shearer*, Dept. of Mechanical Engineering, M.I.T., Cambridge, Mass.
Vice-Chairman: *F. D. Ezekiel*, Dept. of Mechanical Engineering, M.I.T., Cambridge, Mass.

Approximate Method for Calculating the Time Response in Linear Time-Varying and Nonlinear Automatic Control Systems, by *B. Naumov*, Inst. of Automatics and Telemechanics, Moscow, USSR. To be presented by *George Newton*, Dept. of Electrical Engineering, M.I.T., Cambridge, Mass. (ASME Paper No. 60—JAC-10)

An Approach to the Design of Power Servomechanisms, by *D. V. Stallard*, Feedback Controls, Natick, Mass. (ASME Paper No. 60—JAC-1)

Improvement of the Power Efficiency of a Hydraulic Control System by the Use of a Gain Compensated Control Valve, by *S. Y. Lee*, Dept. of Mechanical Engineering, M.I.T., Cambridge, Mass. (ASME Paper No. 60—JAC-8)

Feedback Dinner—New England Lobster and Clam Buffet 5:30 p.m.

Report on the First IFAC Congress, Moscow, USSR, June 27–July 2, 1960 8:00 p.m.

Chairman: *H. Chestnut*, first-president of IFAC, control systems engineer, Gen. Engineering Lab., Gen. Elec. Co., Schenectady, N. Y.

At this evening meeting, a team of outstanding automatic-control specialists will report on technical developments observed first-hand at the First IFAC Congress at Moscow, USSR.

These reports will include an analysis of the present status and future trends in the areas of automatic control theory, scientific and industrial applications, and control system components.

A period of open discussion will follow presentation of the formal report.

Announcement

ISA will sponsor the 1961 JACC to be held at the University of Colorado, Boulder, Colo., June 21–23, with the active participation of ASME, AIEE, IRE, and AIChE. R. K. Adams, Oak Ridge National Laboratories, is General Chairman. A high light of the Conference will be the $100 American Automatic Control Award for the best paper presented at the 1960 JACC.

▶ FRIDAY, SEPTEMBER 9

Special Topics 9:00 a.m.

Chairman: *W. Van der Velde*, Dept. of Aeronautics and Astronautics, M.I.T., Cambridge, Mass.
Vice-Chairman: *H. Mori*, Hydel, Inc., Waltham, Mass.

Integral Transforms for Algebraic Analysis and Design of a Class of Linear-Variable and Adaptive Control Systems, by *G. W. Johnson*, Advanced Systems Research, IBM, Oswego, N. Y. (IRE Paper No. 60AC—10)

Regression Techniques in Multivariate Adaptive Control Systems, by *A. B. Bishop*, Dept. of Industrial Engineering, Ohio State Univ., Columbus, Ohio, and *H. R. Chope*, Industrial Nucleonics Corp., Columbus, Ohio (IRE Paper No. 60AC—11)

Optimum Design of Passive-Adaptive, Linear Feedback System With Varying Plants, by *P. E. Fleischer*, Electrical Engineering Dept., New York Univ., New York, N. Y. (IRE Paper No. 60AC—12)

Investigation of Periodic Modes of a Sampled Data Control System Containing a Saturating Element, by *W. E. Meserve* and *H. C. Torng*, Dept. of Electrical Engineering, Cornell Univ., Ithaca, N. Y. (ASME Paper No. 60—JAC-9)

Case Histories and Computers for On-Line Control Systems 9:00 a.m.

Chairman: *R. G. Lex*, Leeds and Northrup Co., North Wales, Pa.
Vice-Chairman: *H. R. Koen*, Minneapolis-Honeywell Regulator Co., Industrial Div., Philadelphia, Pa.

Programming for Process Control, by *E. Borgers*, Thompson-Ramo-Wooldridge Products Co., Beverly Hills, Calif. (AIEE Paper No. CP—60-975)

Computer Control System for a Continuous Annealing Line, by *J. T. Bradford, Jr.*, Jones and Laughlin Co., Pittsburgh, Pa., and *R. W. Kirkland*, Gen. Elec. Co., Schenectady, N. Y. (AIEE Paper No. CP—60-976)

Process Control Computer System for Vinyl Chloride Manufacturing at B. F. Goodrich Chemical Company, Calvert City, Ky., by *H. Flum*, Thompson-Ramo-Wooldridge Products Co., Beverly Hills, Calif. (AIEE Paper No. CPA—60-5041)

Hybrid Computers for Process Control, by *G. Birkel, Jr.*, Radiation, Inc., Melbourne, Fla. (AIEE Paper No. CP—60-978)

Panel Discussion—Automatic Control Education 9:00 a.m.

The Role of the University in Control Technology

A panel discussion by four educators and a representative from industry on these questions:

(*a*) Is there such a thing as an academically prepared control engineer?
(*b*) What would be the ideal academic preparation for this field?
(*c*) What kind of graduate control specialists does industry want?
(*d*) What kind of research in control technology can universities undertake?
(*e*) What kind of aid can industry give to universities to help develop competence in control technology?

Moderator: *L. E. Slater*, executive director, Foundation for Instrumentation Education and Research, New York, N. Y.

Panelists: *D. P. Eckman*, director, Systems Research Center, Case Inst. of Tech., Cleveland, Ohio
E. F. Johnson, professor of chemical engineering, Princeton Univ., Princeton, N. J.
J. L. Shearer, associate professor of mechanical engineering, M.I.T., Cambridge, Mass.
S. W. Herwald, vice-president, research, Westinghouse Elec. Corp., Pittsburgh, Pa.
J. R. Ragazzini, Dean of Engineering, New York Univ., New York, N. Y.

Nonlinear Systems 2:00 p.m.

Chairman: *G. S. Axelby*, Fellow Engineer, Westinghouse Air Arm Division, Baltimore, Md.
Vice-Chairman: *H. A. Miller*, manager, Electronic Development Div., Taylor Instrument Co., Rochester, N. Y.

On Minimum or Maximum Expected Deviation From an Unstable Equilibrium Position of a Randomly Perturbed Control System, by *Masanao Aoki*, Numerical Analysis Research, Univ. of California, Los Angeles, Calif. (IRE Paper No. 60AC—1)

A Nonlinear Analysis Technique for an On-Off Servo, by *R. Farrah*, Research Labs. Div., Bendix Corp., Detroit, Mich. (IRE Paper No. 60AC—2)

Synthesis of High-Order Nonlinear Control Systems With Ramp Input, by *Chi-Neng Shen*, Dept. of Mechanical Engineering, Rensselaer Polytechnic Inst., Troy, N. Y. (IRE Paper No. 60AC—3)

A Phase Space Investigation of Bi-Stable Systems by Means of Vectors, by *R. V. Halstenberg*, Convair, San Diego, Calif. (IRE Paper No. 60AC—4)

Optimum Control of Chemical Processes 2:00 p.m.

Chairman: *T. J. Williams*, Monsanto Chemical Co., St. Louis, Mo.
Vice-Chairman: *A. M. Fuchs*, Boonshaft and Fuchs, Hatboro, Pa.

Dynamic Solution to a Generalized Chemical-Processing Model, by *R. E. Boydston*, Information Systems, Inc., Skokie, Ill. (AIEE Paper No. CP—60-979)

Considerations in the Design of a Dynamic Control System for Generalized Chemical-Processing Model Considered as a Nonlinear System, by *A. E. Beecher* and *L. A. Gould*, Systems Lab., M.I.T., Cambridge, Mass. (AIEE Paper No. CP—60-980)

Optimization of a Chemical-Processing System, by *J. H. Decanini* and *L. A. Gould*, Systems Lab., M.I.T., Cambridge, Mass. (AIEE Paper No. CP—60-981)

Dynamic Optimization and Control of a Stirred Tank Chemical Reactor, by *W. Kipiniak* and *L. A. Gould*, Systems Lab., M.I.T., Cambridge, Mass. (AIEE Paper No. TP—60-982)

Joint Automatic Control Conference: Order Form for Technical Papers

Only numbered papers in this program are available in separate copy form. Copies can be obtained by completing this mail order form and mailing it to ASME Order Department, 29 West 39th Street, New York 18, N. Y. Please circle numbers.

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1960 ASME Petroleum Conference in New Orleans, September 18–21

More than 1000 mechanical and other engineers and executives from the petroleum and allied industries are expected to gather at the Jung Hotel in New Orleans, La., when the 15th annual Petroleum Mechanical Engineering Conference of The American Society of Mechanical Engineers gets under way on September 18.

They will participate in an outstanding technical program which is presently getting its finishing touches from the operating committees as well as inspection trips to petroleum installations in the area.

The program consists of 26 sessions at which will be presented 54 technical papers and three panel discussions. Included in the panel discussions are the Pressure Vessel and Piping Code sessions.

The Technical Program. The program being prepared for the conference promises to make it one of the most outstanding conferences ever held to meet the needs of mechanical and other engineers in the petroleum industry.

Drilling and production men will be interested in papers being presented on the subject of offshore operations. One paper will discuss pipe stresses when drilling from a floating vessel and will present formulas and curves showing limits for bending stresses in drill pipe or casing due to ocean current drag plus vessel roll and displacement. General aspects of offshore automation will be explored in another. Among other paper subjects are: Economic considerations in the design of a 15,000-lb working pressure-blowout preventer, mechanical aspects of rig moves, radioactive fluid-density measurement, and recent developments in field-gas handling facilities.

Those concerned with engineering design will be interested in a session planned by the Refining-Gas Products-Petrochemicals Committee on the subject of design techniques. Recent innovations involve use of the twin tools of models and photography. Consideration will be given to the types of models commonly used, and how they are prepared. Use of photography will be discussed in two papers; one on utilization of photography in plant engineering, and the other, maintenance applications of photography. Other papers planned by the Committee include such subjects as engine turbocharging, continuous corrosion monitoring with corrosion probes, and pressure-vessel design. Included also are two Code panels, vessels and piping.

The Transportation Committee has prepared an attention-catching program. Compressor station and pipeline automation will be covered in two papers. One session will be devoted to the use of computers in pipeline operations, with a paper covering computer analysis of the hydraulics of a heated oil pipeline, and another on the computer simulation of marine terminal and pipeline operations of the Trans-Arabia Pipe Line Company. Other subjects include branch-connection design, pipeline metering with turbine-type meters, and noise-abatement methods in meter and regulator stations.

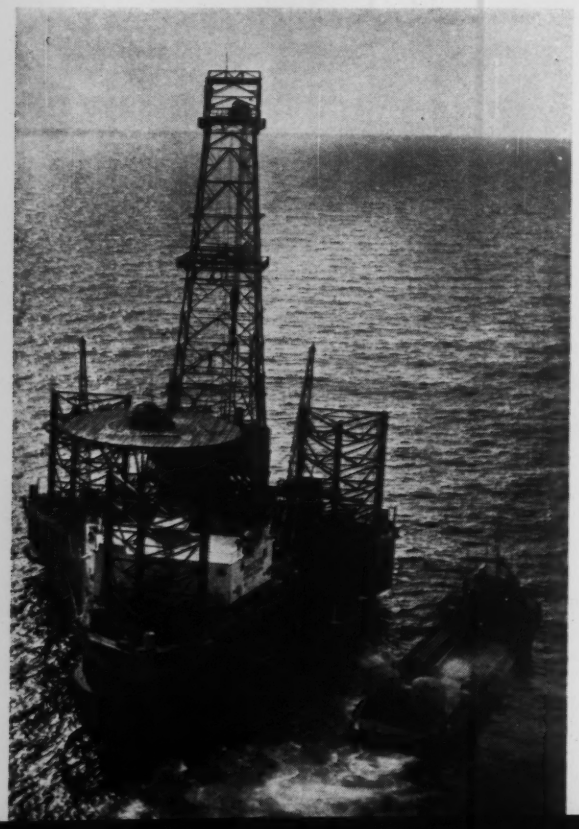
The Materials Committee will sponsor papers on bimetallic pipe, heat-exchanger tubes, use of thin wall pipe for natural gas transmission, and use of ultrasonic devices in nondestructive testing. One session will cover constructional steels and their application in the petroleum industry, and automation of the drilling rig.

Recent developments in manufacturing techniques will be covered in one session sponsored by the Manufacturing Committee. Papers will cover explosive forming of metals, high-speed tool steels, and ceramic tools. Another interesting session planned by the Manufacturing Committee is a panel session on encouraging creativity by company policy on patents, royalties, awards, and so on. Other topics include numerical machine-tool control, probability plotting, and electronic process-control instruments.

The Social Program. The host conference arrangements committee of the New Orleans Section has planned a series of social activities. Considering the charm of the Crescent City, no activity is planned for Monday night, thus allowing everyone a free night to spend as he chooses without being tempted to pass up a conference function. The Sunday afternoon "Get Acquainted Reception" is being expanded to include a social hour.

The Hon. de Lesseps S. Morrison, Mayor of New Orleans, will welcome the conference participants to the city at the Welcoming Luncheon on Monday. Harold Grasse, Vice-President of ASME Region VIII, will respond to the welcome, and the major address will be given by ASME President Walker L. Cisler.

The industry luncheons will be held at noon on Tuesday. These are official meetings of the five operating committees of the Petroleum Division. The luncheons are designed to provide an opportunity for conference attendees to meet the members of the various committees and to discuss with them common



Dixilyn Rig Jolie Ann drilling off Louisiana coast—3½ miles—for Shell Oil Company

problems and proposed subjects for papers.

The traditional banquet, high light of the conference, will be held on Tuesday evening. Harry H. Hudson, Division Commercial Manager, Southern Division, Southern Bell Telephone Company, is scheduled to be the principal speaker.

Inspection Trips. Inspection trips are planned for Thursday, September 22, after the close of the technical program.

Included among the proposed inspection trips are offshore drilling installations.

Women's Program. On Monday afternoon the women will go on a tour of the Garden District where they will be shown some of the finest ante-bellum houses of the oldest "American" quarter in New Orleans. On Tuesday the program includes breakfast at Brennen's and a walking tour of the Vieux Carre.

ASME Officers Nominated for 1961

Members of the ASME Nominating Committee for 1960, J. C. Reed, *chairman;* J. W. McKiernan, *secretary;* R. B. Dowdell, W. B. Moen, W. E. Hammond, J. D. Carr, T. R. DuBois, E. E. Day, E. P. Partridge, H. E. Aldrich, and G. B. Thom, have nominated for 1961 the following:

Office	Nominee
President	William Henry Byrne
Vice-President (for two years)	George Boyd Thom, Region II
	Roy Crawford Robertson, Region IV
	Donald J. Bergman, Region VI
	Eaton Hamilton Draper, Region VIII
	Allen Harold Jensen, Region X
	Harold Grasse, Region VII (one year)
Directors (for four years)	James Bernard Jones
	Rolland S. Stover

ASME COMING EVENTS

August 15–17

ASME-AIChE Heat Transfer Conference and Exhibit, Statler Hilton Hotel, Buffalo, N. Y.

September 7–9

ASME, AIChE, AIEE, IRE, ISA Joint Automatic Control Conference, Massachusetts Institute of Technology, Cambridge, Mass.

September 15–16

ASME-AIEE Engineering Management Conference, Morrison Hotel, Chicago, Ill.

September 18–21

ASME Petroleum Mechanical Engineering Conference, Jung Hotel, New Orleans, La.

September 21–23

ASME-AIEE Power Conference, Bellevue-Stratford Hotel, Philadelphia, Pa.

October 9–12

ASME Rubber and Plastics Conference, Lawrence Hotel, Erie, Pa.

October 17–19

ASME-ASLE Lubrication Conference, Statler Hilton Hotel, Boston, Mass.

October 24–25

ASME-AIME Fuels Conference, Daniel Boone Hotel, Charleston, W. Va.

November 27–December 2

ASME Annual Meeting, Statler Hilton Hotel, New York, N. Y.

March 5–9, 1961

ASME Gas Turbine Power Conference and Exhibit, Shoreham Hotel, Washington, D. C.

April 10–11, 1961

ASME Maintenance and Plant Engineering Conference, Bancroft Hotel, Worcester, Mass.

May 22–25, 1961

ASME Design Engineering Conference and Show, Cobo Hall, Detroit, Mich.

June 11–15, 1961

ASME Summer Annual Meeting, Statler Hilton Hotel, Los Angeles, Calif.

June 14–16, 1961

ASME Applied Mechanics Conference, Illinois Institute of Technology, Chicago, Ill.

September 14–15, 1961

ASME-AIEE Engineering Management Conference, Hotel Roosevelt, New York, N. Y.

September 24–27, 1961

ASME Petroleum Mechanical Engineering Conference, Muehlebach Hotel, Kansas City, Mo.

November 26–December 1, 1961

ASME Winter Annual Meeting, Statler Hilton Hotel, New York, N. Y.

(For Meetings of Other Societies see page 87.)

Note: Persons wishing to prepare a paper for presentation at ASME National meetings or division conferences should secure a copy of Manual MS-4, "An ASME Paper," by writing to the ASME Order Department, 29 West 39th Street, New York 18, N. Y. Price to nonmembers 50 cents; to ASME Members, free.

ASME Elects Ten to Grade of Fellow

The American Society of Mechanical Engineers has honored ten of its members by electing them to the grade of Fellow of the Society.

To be qualified as a nominee to the grade of Fellow, one must be an engineer with acknowledged engineering attainment, have 25 years of active practice in the profession of engineering or teaching of engineering in a school of accepted standing, and be a Member of the Society for 13 years. Promotion to the grade of Fellow is made only on nomination by five Fellows or Members of the Society to the Council, to be approved by Council.

The men who were so honored for their outstanding contributions to their profession and to the Society are:

E. W. Weaver

Ernest Witwer Weaver is staff assistant to the vice-president of engineering, Surface Combustion Corporation, Toledo, Ohio. A discussion of his career, extending over the past 43 years, is practically a parallel chronicle of the furnace-manufacturing industry. Mr. Weaver actively participated in every major furnace development and engineering project launched by Surface Combustion since 1926. A true understanding of the engineering processes pertinent to industrial heating applications has resulted in his many contributions of equal importance in the fields of design engineering and construction. He pioneered in the development of mechanisms for operation at high temperatures in industrial furnaces. In the field of furnace automation, he was instrumental in the development and application of hydrualic equipment for industrial furnaces. During World War II, and also during the

Korean conflict, he headed his company's engineering group whose co-operative effort produced over 1/3 of a billion dollars defense equipment. Mr. Weaver has also conducted in-plant courses for engineering trainees. He is the author of a number of articles published in technical trade journals. He holds numerous patents. Mr. Weaver served the Society as a member of the Toledo Section, Executive Committee, and in 1937–1938, as its chairman. He is a registered professional engineer in the State of Ohio.

L. L. Bosch

LESTER LOUIS BOSCH has been a partner of the firm of Bosch & LaTour, Engineers-Consultants, Cincinnati, Ohio, since its founding in 1953. A native Cincinnatian, he was graduated in 1925 from the University of Cincinnati Engineering College with the Professional Degree of EE.

His co-operative work while at the University was with the Allis-Chalmers Manufacturing Company—toolmaking, manufacturing, tests, and design. Upon graduation, and until 1945, he was associated with the Columbia Engineering Corporation, a service organization for the Cincinnati Gas & Electric and Dayton Power & Light Companies. Study and design for which he was responsible resulted in the installation of an a-c network in downtown Cincinnati, one of the pioneering systems in the country. Other responsibilities included design of a similar network for Dayton, Ohio; engineering project manager for the 16-story office building of CG&E; and Power Company Representative on the building of the consolidated railway Union Terminal in Cincinnati. Mr. Bosch was in charge of CG&E's West End Station Unit 5 project, one of the first superimposed high-pressure high-temperature turbine installations. From "Pearl Harbor" to "VE-Day," Mr. Bosch served full time in Washington, D. C., on a "Dollar a Year" basis on the War Production Board (on loan from Columbia Engineering Corporation). In this post he was responsible for land steam-turbine and condenser production, co-ordination of utility and industrial turbine requirements with those of the Navy and Maritime Commission; and for administration of WPB's Lend Lease Steam Power Program. He served as a member of the Combined Production and Resources Board Power Committee and as Chairman of the Turbine Industry Advisory Committee. Later as Chief, Equipment Production Branch, he had cognizance of all U. S. power-equipment production. Special assignments included: A short field study and report on the Panama Canal power situation; and co-ordination of power-equipment production for the Manhattan District Project.

Following cessation of hostilities in Europe, Mr. Bosch was appointed Assistant Deputy Personal Representative of the President, with duty in China. There he participated in discussions of broad policy and co-ordinated the activities of technical specialists who were working to increase the indigenous production of Free China—thus to relieve "over the Hump" tonnage. He remained for a short period for consultation on certain immediate postwar problems and the power situation in Manchuria. He held the simulated U. S. Army rank of Colonel and was awarded the "Victory" medal by the Chinese Government. Early in 1946 Mr. Bosch joined Jackson & Moreland, Engineers-Consultants in Boston, as project manager. His responsibilities included engineering-economic studies and designs in the fields of hydroelectric, steam-electric, and paper-mill process work. These activities centered largely in New England and Puerto Rico.

During 1952 and early 1953, Mr. Bosch was on loan from Jackson & Moreland to the General Electric Company, in charge of engineering design co-ordination and construction of the Aircraft Nuclear Propulsion Project in Cincinnati.

Mr. Bosch taught for many years in the Evening College of the University of Cincinnati and has made significant contributions to the development of low-reactance busway systems. Patents have been granted to him pertaining to traffic safety, instruments, busways, and insulation.

Recognition has been given to his contributions in the fields of material handling and automation. Mr. Bosch, who has been a member of ASME since 1946 and a past-chairman of the Boston Section and the Cincinnati Section, received the "Engineer of the Year" Award in 1959 from the Cincinnati Technical and Scientific Societies Council. He is a Fellow in AIEE and served as Chairman of Cincinnati Section and as Chairman of the Lamme Metal Committee. Other engineering society affiliations include Life Member of Eta Kappa Nu; Life Member and past-president of Engineering Society of Cincinnati; member, NSPE, Atmospheric Control Association, and American Ordnance Association. He was one of the founders and first president of the Cincinnati Technical and Scientific Societies Council.

C. F. Kayan

CARL FREDERIC KAYAN, professor of mechanical engineering, Columbia University, has contributed to many fields, but he has earned one of the most honored places of any professor in the hearts of students for he loves to teach. He has been with Columbia University since 1925 and was awarded the Society of Older Graduates' "Great Teacher Award" in 1959. Professor Kayan has made outstanding contributions in research in important areas of heat transfer, air conditioning, and refrigeration. He has written more than 30 articles discussing geometrical and network electrical analogs as a means for solving complex heat-transfer problems, and 15 publications for The Refrigeration Research Foundation. As a United States delegate to the International Institute of Refrigeration he presented papers in Moscow and Prague. He was visiting professor at the Royal Institute of Technology in Sweden in 1955. He presented papers at the ninth International Congress of Applied Mechanics in Brussels, and was the U. S. observer at the Louvain and Zurich meetings of the International Institut du Froid in 1956. Acknowledged as a pioneer in the electric simulation of energy flow and a recognized authority, he has delivered a series of lectures under the auspices of the Advisory Group for Aeronautical Research and Development under NATO in Holland, Germany, Italy, and Norway. His honors abroad have demonstrated his great pioneering efforts in the energy-flow analysis area in rheoelectrical simulation. He has represented the Engineers Joint Council as Committee Chairman on the Recognition of Specialties in Engineering and has been active in promoting national relations in technical and engineering fields. He has been president of ASRE and is Fellow ASRE, ASHAE, and AAAS. He was elected honorary vice-president of the John Ericsson Society of New York. He was a founder and president of the Instrument Society of America, is president of the Commission on Heat Transfer, Insulation and Instrumentation of the International Institute of Refrigeration; and member also of the Air Pollution Control Board of New York; New York Academy of Sciences, Sigma Xi, Tau Beta Pi, and Pi Tau Sigma. As chairman of the Program Committee of Section M (Engineering) of the American Association for the Advancement of Science, he has for the past several years organized symposiums on the National and International Aspects of Systems of Units.

Kerr Atkinson

KERR ATKINSON, consulting engineer, specializes in all phases of industrial and public utility power—generation, purchase, distribution, and application, with emphasis on correlation of steam and electric supply in design of industrial plants and systems for best service and economy. During his career he has been instructor of electrical engineering, University of Missouri, electrical engineer with Lehigh Valley Coal Company, Wilkes-Barre, Pa.; lieutenant of engineers in the U. S. Army during World War I; and, prior to setting up his private practice, spent 26 years as project engineer with Jackson & Moreland, Boston, Mass. In this time he designed new boiler and power installations for many utility companies. He also directed designs and studies on projects including sewage pumping, wind tunnels, aircraft gas turbines, free-piston diesel compressors, gas-turbine laboratory for the United States and foreign governments, educational institutions, municipalities, industries, and public utilities. In private practice his services have been employed by government agencies including Army, Navy, Air Force, and the Department of Justice as well as industrial firms and utilities. He is an expert on utility-power-rate schedules, accounting systems, appraisals, and power-network analyses. Recently he has been active in development of new cycles for efficient power generation by combining the steam regenerative cycle with that of the simple and regenerative gas turbine. Mr. Atkinson is a registered professional engineer in several states and holds a Certificate of Qualification from the National Bureau of Engineering Registration. He is a past-president of Engineering Societies of New England, past-chairman of the Board of Water, Sewer, and Municipal Light Commissioners of Wellesley, Mass., and a life member of AIEE. In 1955 he was awarded a certificate of merit for his design for a symbol for the ASME 75th Anniversary celebration. At various times he has served the Society as chairman of the Boston Section; as Regional Adviser to and member and chairman of Publications Committee; as member of the Professional Practice Committee; and is currently serving as chairman of the Board on Technology.

G. B. Hauser

GILBERT BATES HAUSER, manager, Railroad Section-Sales Development Division, Aluminum Company of America, New Kensington, Pa., has been engaged in much pioneering work in the designing and application of aluminum alloys to all types of railroad equipment. The successful operation for periods of up to 25 years of aluminum hopper cars, boxcars, refrigerator cars, passenger-car bodies, tank cars, and other related equipment is a testimony to the sound engineering principles and guidance employed by him in his work. He assisted in the design and supervised construction of all-aluminum double-deck suburban cars, and is responsible for the design and application of aluminum parts to hopper cars for various railroads, for a three-ton insulated container for shipment of frozen foods, for an aluminum banana car, grain doors for boxcar doors, and aluminum superstructure and floor racks for refrigerator cars, among others. He directed the design of aluminum baggage car doors, a collapsible container for shipment of shortening, cold air ceiling ducts for mechanical refrigerator cars, railroad-highway crossing gate arms, and railroad crossbucks made of extruded aluminum. Almost 4000 aluminum tank cars in which he played a prominent part during early development, are now in service. In World War II, he played a major part in developing an aluminum aircraft landing mat. He has designed an aluminum, passenger-bus body. He has authored several publications on the use of aluminum in railroad cars. He is an associate member of the American Railway Engineering Association. Mr. Hauser is a registered professional engineer in the Commonwealth of Pennsylvania.

J. W. Barker

JOSEPH WARREN BARKER, retired, past-president of ASME, 1955–1956, has had an engineering career equally distinguished in education and in industry. From 1930 to 1946 he was dean of the School of Engineering at Columbia University, after which be became president of the Research Corporation and Research Cottrell, Inc., a nonprofit educational and scientific organization to advance research and technology by use of revenues from patents. He has taught at M.I.T. and Lehigh University. On leave from Columbia, he served as special assistant to the Secretary of the Navy and received U. S. Navy Distinguished Civilian Service Award. While his greatest contribution has been in the production of equipment for the prevention of atmospheric pollution, he has been active in promoting research in such unrelated fields as chemistry, nutrition, physics, and nuclear science. His attainments have been recognized by his honorary degrees from Case School of Applied Science, University of Rochester, Bucknell University, Union College, Northeastern University, Ripon College, and Muhlenberg College. He was elected Fellow, AIEE, and has served as vice-president. He is past-president of Sigma Xi, IES, and EJC, and member of ASCE, AAAS, Tau Beta Pi, AIME, ASEE, and EIC. As representative of the United States, Mr. Barker attended the Organization for European Economic Co-operation Conference on Research Administration held in France in 1954. He has been an active member of The Engineering Foundation Board, serving as its chairman. From 1950–1952, Mr Barker was a member of the Committee on Technical Assistance of the International Relations Commission of the EJC. A registered professional engineer in New York State since 1931, he is a member of the Newcomen Society of England; The Engineers' Club, The Century Association, The University Club, and the Columbia University Club, all of New York. He has been a member of the Advisory Committee on the U. S. Coast Guard Academy and served as its chairman.

D. W. McLenegan

DAVID WALLACE MCLENEGAN, consulting engineer, General Electric Company, Richland, Wash., has made recognized contributions to the science of engineering during 38 years of practice in mechanical and electrical engineering. For 17 years he has been a member of ASME; and, in 1953, he was elected to the Fellow grade of AIEE. He holds 14 patents on motor and control systems as well as air conditioning and refrigeration. Mr. McLenegan has contributed actively to motor applications to mechanical loads of unusual characteristics including the first applications of synchronous motors to CO_2 compressors involving special torque and flywheel requirements, first application of a direct-connected synchronous motor to a vertical ball mill with over-voltage starting, and the application of synchronous-induction motors and related control to large hammer mills to provide special characteristics. In the development of heat pumps for all-season air conditioning, he conceived, planned, and directed the designs of a series of prototype installations of 20 to 60 tons capacity, each demonstrating a different method of supplying heat during extremely cold weather. He participated in the development and first application of forced-oil, forced-air cooling to large power transformers. Later, he developed a training program, the first in the nuclear field,

Technical Data on Plastics

THE ASME Rubber and Plastics Division wishes to bring to the attention of the general membership of the Society an extremely valuable compilation of technical data on plastic materials entitled, "Technical Data on Plastics," $8^1/_2 \times 11$ in., hard cover binder, $3.25, 1957 edition; order from Manufacturing Chemists' Association, Inc., 1825 Connecticut Avenue, N.W., Washington 9, D. C.

whereby new graduates in science and engineering could gain experience in technical activities within a large security-restricted plant. He was a leader in the development of the Graduate School of Nuclear Engineering in the Hanford plant at Richland, Wash. Mr. McLenegan is a member of the American Institute of Electrical Engineers, American Nuclear Society, American Society for Engineering Education, and has served on the Technology Advisory Board, Washington State University. He is a registered engineer in the states of Washington and New York.

J. H. Sams

JAMES HAGOOD SAMS, dean of engineering, Clemson College, has been active in engineering for 33 years, and an engineering teacher for 18 years, during which time he was recognized by his students for the clarity of his presentation and strict standards of performance. For five years he was an officer in the Army Air Force where his work in research on turbosuperchargers and his liaison work with the British Air Ministry in London and with the Bureau of Aeronautics in Washington brought him decorations from the War Department. Since he has been Dean of Clemson College the engineering curriculums have been revised, three additional curriculums have been added to the ECPD accredited list, and a new curriculum in industrial engineering has recently been established. Dean Sams has been active in ASME, serving as Secretary and as Chairman of the Greenville Section, for three years as a member and chairman of the Sections Committee of Region IV, a member of the National Registration Committee, and from 1956–1958 as Vice-President of Region IV of ASME. Dean Sams also served as an alternate representative of ASME on the Board of Directors of Engineers Joint Council in 1957 and as Representative of ASME from 1958 to 1960. He has been a registered engineer of South Carolina for 31 years and served as a member of the State Board of Engineering Examiners for 11 years. His service was recognized in 1957 when he was awarded the Distinguished Service Certificate of the National Council. For the past five years he has served as a representative of NCSBEE on the Board of Directors of Engineers' Council for Professional Development. He has been a member and president of the South Carolina Society of Engineers, and member of ASEE.

H. A. Mosher

HAROLD ARTHUR MOSHER has made technically superior contributions to the engineering profession. He began his career in research and development of electromechanical vibrating systems such as telephone receivers and transmitters with the engineering technical staff of Bell Telephone Laboratories, New York City. Then he was a member of the engineering staff of Consolidated Film Industries, Fort Lee, N. J., concerned with manufacturing facilities for processing motion-picture film. Since 1934 Mr. Mosher has been with Eastman Kodak Company, Rochester, New York. He was responsible for the design and development of major facilities used in manufacturing of photographic materials, particularly sensitized paper manufacturing. He was promoted to Associate Director of Engineering in an engineering division of approximately 525 members covering a broad portion of mechanical, chemical, civil, and electrical fields concerned with creation, design, and production of facilities and machinery for manufacturing high quality and complex photographic products. He has given freely of his time and made real contributions to the engineering profession and professional engineering societies at all levels (local, state, and national). He has served on the Board of Directors of the NYSSPE and as chairman of the State Membership Committee. His service and contributions to the National Society of Professional Engineers include member of the Membership Committee, chairman of the Memberhsip Committee, member of the Board of Directors, vice-president, and presently serving as president. He is the author of four publications. Mr. Mosher is a registered engineer in the State of New York.

J. W. Huckert

JESSE WILLIAM HUCKERT is an engineer with broad experience in teaching, writing, and machine designing. Holding four degrees, BS(ME) and BS(EE) from the University of South Dakota, MS from the University of Illinois, and PhD from Cornell University, he has a strong scientific background. During the 1920's he taught in the Speed Scientific School of the University of Louisville in Kentucky. In the late 1930's he was an associate professor at the University of Maryland and after World War II, a professor of mechanical engineering at The Ohio State University. During World War II, in the U. S. Navy, he was an assistant to the officer in charge of the Design Division of the Naval Gun Factor, Washington, D. C., and the safety officer of the Navy Yard at Pearl Harbor. His engineering design experiences began in 1930 with the Gleason Works, Rochester, N. Y. Later, he was employed by Bausch and Lomb Optical Company also of Rochester and the Jeffrey Manufacturing Company, Columbus, Ohio. More recently and until this year he was chief engineer of Carpenter Body Works in Mitchell, Ind. While teaching he wrote the book, "Analytical Kinematics of Plane Motion Mechanisms." He also edited the volume on Engineering Tables for the ASME Metals Engineering Handbook Library. Other writings include the coauthorship of two research bulletins and several technical articles. In 1945–1947, Dr. Huckert was on the editorial staff of *Product Engineering*, McGraw-Hill Publishing Company, New York, N. Y. Only this year he returned to full-time writing. He is now an associate editor with *Machine Design*, The Penton Publishing Company, Cleveland, Ohio. Although he has held memberships in several technical, professional, and honorary organizations, he presently retains memberships only in ASEE (1938) and ASME (1929).

Pamphlet Papers: Prices Increased

RISING editorial, paper, and production costs have forced the Publications Committee to increase prices for pamphlet copies of technical papers. At the same time, the increase will also provide price uniformity with our sister societies with whom we hold a number of Joint Conferences. Effective with meetings and conferences held after July 1, 1960, therefore, prices of pamphlet papers will be increased to $1 to nonmembers; 50 cents to ASME members. Prices for books of ten coupons will be $8 to nonmembers; $4 to ASME members.

Conducted for the National Junior Committee

J.W. FOLLANSBEE[1]

JUNIOR FORUM

How American Business Can Recapture Its Pioneering Spirit

On October 16, 1959, Louis E. Wolfson, chairman of Merrit-Chapman & Scott Corporation, gave an address before The Executives Club of Chicago. He aimed his words at business executives, but his thoughts apply to all engineers and scientists, young or old, top rung or bottom, directly involved with business problems or not. The following paragraphs give, in condensation, Mr. Wolfson's answer to the threat of conformity in American business—American life.

How can American business recapture its pioneering spirit, end the threat of conformity, and meet the challenge it faces?

The hard fact is that American business leadership no longer emphasizes the pioneering spirit which helped build this nation. At the same time, Soviet Russia has embraced pioneering and it is becoming powerful. Russia has grown in 30 years from a backward position into the second largest industrialized nation in the world. She's made this advance because her people want new paths, are eager to innovate and to progress.

If we are to meet growth in nations opposed to our concepts, Americans must recapture the pioneering spirit in every phase of national life. This applies particularly to the business structure, for it is basic to our national well-being.

Yet most people, businessmen included, think of pioneering as serving the national welfare in a narrow way. For them, all roads to new frontiers now lie only through science and technology.

Call for Pioneers. Newspaper ads the country over plead for scientists and engineers with creative, pioneering ability. These ads promise such men every opportunity to develop their own ideas; they offer them every corporate resource.

This is good. But science alone cannot solve all our problems. We must encourage equally this spirit of pioneering and adventure throughout our entire business structure. Business admires and pleads for creativity and pioneering in science, but increasingly discourages these same qualities in other areas.

In too many firms, business turns thumbs down on pioneering and exploring by executives. Instead, business practices conformity. "Do as others have done before you" is the motto. Although businessmen talk about the need for "new blood," it is generally just that—so much talk. A recent article in *Nation's Business* pinpoints this attitude. Business actually wants, the writer says, "creative conformists who are proved profit-makers with vision."

This is a generalization only. I've found many corporation presidents recognize the dangers in this conformity trend; they see the need for pioneering at all levels of business. Others express reservations. They wonder if creative initiative will disrupt established company procedures. It doesn't have to. You can combine, practically, initiative with a chain of command and still not make a cult of nonconformity or throw out discipline and control.

In a previous talk I said that "robot executives" form a growing threat to American industry. Regardless of their business success, these men are reluctant to break precedent. Canada Dry's president, Roy W. Moore, Jr., told me too many executives follow the proved road rather than the self-reliant approach. I agree. These men believe a job is more important than a man. Instead of regarding a job specification as simply an orderly definition of a job's needs, they try to fit people rigidly to impersonal job specs. This produces more robots and robot executives.

As a case in point, a young business-school graduate wrote to me complaining about stock answers received in response to some of his job applications. One said, in part: "At present time, we are unable to locate a suitable opening for your particular background. Your qualifications are acceptable and we are sorry our present openings do not match them satisfactorily." This young man wondered, somewhat bitterly, "What employee with any kind of ambition wants a job to 'suit his qualifications perfectly'? If he has any pioneer spirit at all, he will use his interest and abilities to do any job."

In speaking with industrial leaders, one fact particularly impressed me. Whatever their field, businessmen highly respect laboratory research and new product development, yet are skeptical of findings about human personality and how it works. The term "social sciences" raises questions of doubt. Still, social scientists continually discover new facts about our greatest business asset—people, and we should be as willing to adopt such findings as we are the latest chemical or electronic discovery.

Barriers Block the Road. Today, the work going on in many areas—universities, research firms, academic-business conferences—leads us to three basic conclusions:

1 Many barriers—social, business, and individual—block the road to meeting our goals. Here society's pressure against the "nonconformists"—those who question things as they are—is a main retardant.

2 No one rule stimulates fresh ideas. Too many businessmen rely on a magical method: Personnel selection, a suggestion box, decentralization. Each has virtues. But remaking an organization's attitudes, thinking, and action requires a many-sided approach, and it stems from a broad program. And even then every step may not yield the desired result.

3 Most important, a company trying to break conformist patterns must be sure of the top man's or men's attitude. Top management must want to stimulate initiative. And they must want it badly enough to change the thinking climate of the whole organization.

Approaches Toward Attaining Creative Thinking. Now, let's look at six of the many different approaches toward attaining initiative and creative thinking.

1 Management consultants. These seek solutions to company problems through discussion, opinion exchange, and suggestions. Also, some companies use committees at many policy and operational levels. I favor such committees if they don't get too involved in their own functioning and don't deteriorate into yes-men groups.

2 Conferences and training courses. These vary in subject matter from prob-

[1] Designer, Voorhees, Walker, Smith, Smith & Haines, New York, N. Y. Assoc. Mem. ASME.

lem solving to creative thinking. At U. S. Steel's Gary Plant a trainee program puts groups of eight men into the plant. Here they study and observe problem situations involving costs, working conditions, or whatever. They then work out specific ways to better the situation. Result: Trainees gain experience putting their own solutions into action.

An interesting twist on the idea of personnel inventory and self-examination is found at the American Alcolac Corporation. The company requires each professional and managerial member to outline his objectives and future plans for his own work and to embody suggestions for changes and improvements in an annual or semiannual letter to his respective boss. This seems to me a challenging way of developing what we want.

General Electric uses a creative engineering program. It stresses engineering fundamentals, materials and processing, and presentation of ideas and human relationships. Before the first half of a course is completed, each student creates an idea, works it out on paper, and builds a working model. Program graduates continue to come up with new usable ideas at an average rate almost three times that of the nongraduates. GE aims the plan specifically to further creative engineering. It applies, it seems to me, to trainees of every kind.

3 "Freedom to Fail," defined as "freedom to act, take risks, make decisions—and do so without fear of consequences," is the program at American Brake Shoe. ABS delegates authority to solve problems to both top and lower echelon executives and to rank and file people. Foremen, for instance, help negotiate union contracts. The company does not penalize failure if a man sincerely and intelligently tried to innovate a new idea.

I am greatly intrigued by this method. Obviously, decentralization must go with this approach—something which I support.

4 Kimberly-Clark Corporation uses a reserve bank of men of diverse backgrounds who act as a team to solve problems. None are specialists, though they may consult specialists if they wish. The group has its own budget, lab, and machine shop. I see the value of the plan and two questions. How many companies can support such a unit? And, might it result in a "creative elite" so powerful in prestige as to discourage initiative in others?

5 "Brainstorming." A group of men toss ideas around, allowing no criticism of poor ones. Later, weeding out occurs. Advocates say brainstorming supplements individual problem-solving. I think thoughtful study by men pounding their brains in solitude is more productive than this type of group titillation.

6 Finally, the old time suggestion-box gets a new dimension. Under the heading "Incentive and Reward," Remington Rand encourages suggestions and supplies an administrator who helps sell them to management. The one limitation appears to be that the innovator must have his idea pretty well developed before coming to the administrator.

Another example is Merritt's Junior Executive Council. Comprised of junior executives, it covers all administrative and operational divisions at headquarters offices. The Council has full latitude to study existing corporate procedures and to recommend changes or innovations. First a Council Committee, then the whole group studies a situation. Proposals surviving first study go to a senior executive committee; they decide which ideas merit further study. Upon getting the green light, the JEC studies further, then makes definite recommendations. Rejects still occur, but the senior committee must explain why to the Council.

To sum up, we face an urgent question. The public thinks of both foreign challenge and national defense in terms of competing scientists perfecting intercontinental missiles and other weapons. Actually, our business economy is a far more basic bulwark and defensive weapon.

Chairman's Corner

AT A RECENT Boston Section meeting a Member said he thought qualifications for membership in ASME should be made more stringent to make membership more meaningful. Assuming that there would be fewer members, and taking cognizance of Society finances, he added that he would like to see membership restricted even if it meant increasing the annual dues to $50.

Although the suggestion runs counter to present ASME policy, it is based on the experience of a capable engineer who has served the Society actively for many years. It is this sort of question that makes you stop and think: "Is my ASME membership worth $10 or $20 a year to me?" Or, "Will it ever be worth $50?"

Many Student Members ask themselves this question each year as they consider their opportunity to transfer to Associate Grade without the initiation fee. Still others decide to drop out after a few years as members. They have attended possibly one section meeting since graduation. They've thumbed through MECHANICAL ENGINEERING looking for an article concerning their own particular specialty and have not found it. Because they have not taken it upon themselves to put their membership into active use, the decision to drop out comes easily.

Although it doesn't seem likely, the day of $50 dues may come. Perhaps company sponsorship will be required before a nominee's qualifications will be reviewed under more stringent requirements; and ASME membership will be the hallmark of only the most capable engineers (covering all degrees of experience). There is little doubt that membership would be desired generally under the latter conditions.

Will you have taken a part in the shaping of this policy? The opportunity exists today. Up to now have you given your membership a real trial by taking an active part in your Section's operation? Submitting a technical paper? Or volunteering to participate in the areas of activity sponsored by the National Junior Committee? Perhaps you are destined to become another drop by default.

Cause: Lack-o'-participation.

Result: X years of dues down the drain.

Norman J. Viehmann, *Chairman*
National Junior Committee
Product Planning Engineer
Department 142
Western Electric Company
North Andover, Mass.

If the "Forum" is to live up to its title, it should express your views and ideas. Please express them to Jim Follansbee or Norm Viehmann.

To maintain this economy in a growing state, we must revitalize a key American resource badly neglected—the individual in the business structure. American business must permit the individual to make his fullest possible contribution, rather than relegate him to the role of a well-oiled automaton. By doing so, we can recapture the pioneering spirit that made America.

I now believe many people in many fields recognize the seriousness of "robot conformity." They are trying to overcome it. I know they will at least inject new life into American business.

Copies of Mr. Wolfson's complete address can be obtained by writing to Merritt-Chapman & Scott Corporation, 261 Madison Avenue, New York 16, N. Y.

ASME Power Show to Highlight New Developments

MAJOR companies serving the power industry are already planning exhibits for the 24th National Exposition of Power and Mechanical Engineering, preparations for which are well advanced. Several will introduce methods and equipment that have been successful in other areas but are new to the power field. Others will enter the Exposition for the first time with equipment calculated to expedite conventional procedures. The Exposition will be held at the New York Coliseum, November 28 to December 2.

As heretofore, the Power Show will be held under the sponsorship of The American Society of Mechanical Engineers in conjunction with its annual meeting to be held at the Hotel Statler. Since its inception the biennial exposition has been under the management of the International Exposition Co., which is permanently located in New York.

New Displays. This year new displays will include heaters and heat-transfer equipment, lubrication and energy-control systems, pumps and compressors, and fans and blowers. New exhibits in several other categories also will be on view.

Scope. The Exposition presents a full panorama of the power field from planning services and plant design to construction, equipment, and maintenance of heat and power sources, as well as distribution and control. Equipment for small plants and service industries will be displayed as well as functional units and accessories for generating stations, distribution systems, and light and power networks.

Several displays will be devoted to the introduction of new economies in plant design and operation. The application of computers to the complicated web of piping in large facilities is one area in which positive gains will be demonstrated. Computerized operating control of entire plants is the objective pointed up by other displays.

Installation and alteration of power piping will be accelerated by a unique welding process which insures full-bead penetration of the joint without the use of backing rings. Live demonstrations will show the effectiveness of this method.

Prompted by the continued revision of codes and standards affecting applications of both heat and electricity, considerable equipment has been redesigned, incorporating new material specifications. Continued boosting of operating pressures and temperatures has again stimulated new developments in steam specialties and other power plant accessories. New models will feature many displays.

Headquarters of the International Exposition Company are at 480 Lexington Avenue, New York 17, N. Y. E. K. Stevens, president of the Company, is manager of the Exposition.

ASME-AIEE National Power Conference, Sept. 21–23

THE 1960 National Power Conference will be held in Philadelphia, Pa., September 21–23. This is a joint presentation by the Power Division of both the American Institute of Electrical Engineers and The American Society of Mechanical Engineers. An interesting program has been prepared by the local Sections of both societies. The Conference headquarters will be at the Bellevue-Stratford Hotel.

Registration will be open during the afternoon and evening of Tuesday, September 20, and those arriving early are invited to attend the Early Bird Reception.

Technical Program. From the brief outline of the technical program available at present, the schedule includes two sessions on Wednesday with a panel discussion Wednesday evening. On Thursday, there are two sessions, one in the morning and one in the afternoon, the evening session being omitted to accommodate the banquet which will be held in the ballroom of the Bellevue-Stratford.

The technical sessions on Friday terminate at noon and the program includes inspection trips to local plants in the afternoon of September 23.

The first technical session will be devoted to a discussion of "Co-ordination of Generation and Transmission and Operation." The following sessions will be devoted to papers dealing with "Service Requirements for Industrial Customers" and "Advancement of Power Engineering." On Thursday, the morning and afternoon sessions will cover "Power-Plant Automation," and the concluding session, on Friday, will take up "Advancements in Economic Power Production."

Inspection Trips. Inspection trips are planned for the Eddystone Station of the Philadelphia Electric Company, the Westinghouse Electric Corporation Steam-Turbine Plant, and for the General Electric Company Switchgear Plant. For those visitors who may desire to look over some other interesting plants in the Philadelphia area, special arrangements can be made.

ASME CODES AND STANDARDS WORKSHOP

Interpretations of 1955 Code for Pressure Piping

FROM time to time certain actions of the Sectional Committee B31 will be published for the information of interested parties. While these do not constitute formal revision of the Code, they may be utilized in specifications, or otherwise, as representing the considered opinions of the Committee.

Pending revision of the Code for Pressure Piping, ASA B31.1—1955, the Sectional Committee has recommended that ASME, as sponsor, publish selected interpretations so that industry may take immediate advantage of corresponding proposed revisions. Cases No. 46 and 47 are published herewith as an interim action of Sectional Committee B31 on the Code for Pressure Piping that will

not constitute a part of the Code until formal action has been taken by the ASME and by the American Standards Association on a revision of the Code.

Case 46—Proposed Case for the Use of ASTM A299 Plate for A155 Pipe

Inquiry: ASTM Specification A155 does not list plate made to ASTM A299. May pipe made to Specification A155 using plate meeting the requirements of ASTM A299 be used under Section 1 of ASA B31.1, Code for Pressure Piping?

Reply: It is the opinion of the Committee that pipe made to ASTM Specification A155 using firebox quality carbon-manganese-silicon steel plate conforming to ASTM Specification A299 may be used for power piping systems complying with the Code for Pressure Piping ASA B31.1—1955, Section 1, Power Piping, provided the following requirements are met:

(*a*) Pipe shall be Class 1, heat-treated, double welded and radiographed.

(*b*) Longitudinal joint factor may be taken as 1.0.

(*c*) Allowable stress values (E = 1.0) shall be as follows:

−20 F to 650 F	18,750 psi
700 F	17,700 psi
750 F	15,650 psi
800 F	12,000 psi
850 F	7,800 psi

Case 47—Proposed Case for Wider Use of A381 Pipe

Inquiry: Is the limitation placed on ASTM A381 pipe in Subparagraph 305.2.1 (*d*) of ASA B31.3—1959, Petroleum Refinery Piping, still applicable in view of the increased knowledge available to the Committee?

Reply: It is the opinion of the Committee that for ASA B31.3—1959, Petroleum Refinery Piping, the intent of the Code will be met if ASTM A381 pipe is used without the limitation contained in Subparagraph 305.2.1 (*d*).

Machine Tapers

THE 1960 edition of B5.10 American Standard on Machine Tapers has been prepared with revisions which should clarify their use and application. The standard now includes Tolerances on the rate of taper and more complete data for plug and ring gages used for self holding tapers and steep machine tapers.

In addition, to meet the demand for listing authoritative data on other tapers, sometimes used by industry, information is given in the appendix. These include Brown & Sharpe tapers, Morse tapers, Morse Stub tapers, and Jarno tapers along with Plug and Ring Gage data for them.

The new edition of ASA B5.10 Machine Tapers Standard, in its revised and enlarged form, should fill the widespread demand for information on this subject.

1960 Annual Report of Joint Committee on Uniformity of Methods of Water Examination to Participating Members

THE Joint Committee on Uniformity of Methods of Water Examination has completed its fourth year of operation. As stated in previous annual reports, the objectives of the Joint Committee are: (1) To review the methods of water examination, published by member organizations, for the purpose of obtaining uniformity in sampling, testing, reporting test data, terminology, and in application; and (2) to provide a mechanism for the exchange of information on these matters by member organizations.

The objectives of JCUMWE are accomplished by review panels made up of experts in their fields of specialty. A review panel is established for each method undergoing review.

Official JCUMWE recommendations have been approved for the following: Reporting of results, total hardness, iron, organic nitrogen, grease and oily matter, and solids. The last four were approved during the past year. They have been transmitted to member organizations.

An important precedent was established in the JCUMWE recommendations for grease and oily matter. After thorough study by the panel and by the member organizations, it was decided that it is impossible to reach uniformity for the several methods that were reviewed.

The reasons are that the objectives of the several methods are different, and that the different solvents used in the methods give results for which there is no basis for comparison. It is not unlikely that certain other methods that come under review by JCUMWE may result in similar conclusions.

Reports of three panels were accepted as preliminary recommendations: Sulfates, uniformity of reagents, and acidity, basicity, alkalinity. These recommendations will be sent to member organizations for review and comment.

The following new panels are to be set up as soon as practicable: Turbidity; calcium and magnesium; carbonate, bicarbonate and carbon dioxide; electrical conductivity; fluoride; ammonia; total phosphorus; and nitrite.

Progress was made in certain proposed revisions of the Regulations governing the activities of JCUMWE and also in additions to the Guide.

The American Society of Mechanical Engineers changed from inactive to active status during the past year. This makes 11 of the 12 member organizations that are maintaining active participation in all phases of the program. They are: AOAC, ASTM, AWWA, API, APHA, ASME, MCA, TAPPI, USGS, USPHS, and WPCF. USP still maintains membership for information purposes.

The Society is represented by Joseph W. Strub, Mem. ASME, who is senior service engineer in the Engineering Service Division of the Engineering Department of E. I. du Pont de Nemours & Company, Inc., Wilmington, Del.

How Well Do You Know Your Society?

SO THAT the members of ASME may know their Society, attention is called to the list of Manuals and Annuals available upon request from the ASME Order Department, 29 West 39th Street, New York 18, N. Y.

Unless otherwise noted, all the items in the list will be sent without charge.

AC 2	Annual Report of ASME Research
AC 10	Personnel of Council, Boards, and Committees
AM 1	Membership List—Alphabetical and Geographical (Biennial—odd-numbered years)
AM 3	Catalog of Publications (also included in "Mechanical Catalog")
AM 4	Members List—Listed by Companies (Biennial—even-numbered years, $2 each)
AM 5	Indexes to ASME Papers and Publications
MM 1	Certificate of Incorporation, Constitution, By-Laws, and Rules
MM 2	Know Your Society
MS 4	An ASME Paper (50 cents to nonmembers)
MS 61	Citizenship and Participation in Public Affairs

ACTIONS ASME EXECUTIVE COMMITTEE

A MEETING of the Executive Committee of the Council was held at Onchiota Conference Center, Sterling Forest, N. Y., on Friday, May 6, 1960. There were present: W. L. Cisler, President; W. H. Larkin and R. B. Smith of the Executive Committee; G. B. Warren, past-president; L. N. Rowley and V. W. Smith, Directors; F. L. Schwartz, Organization Committee Chairman; O. B. Schier, II, Secretary; T. A. Marshall, Jr., Senior Assistant Secretary; and L. S. Dennegar, Public Relations Director.

The following actions are of interest:

Board on Technology. *Special Technical Interests Committee.* The Council voted (*a*) to approve the plan as presented by the Special Technical Interests Committee, and (*b*) to refer the plan to the Constitution and By-Laws Committee for preparation of the necessary By-Law changes.

Board on Honors. *1960 Awards.* The Board on Honors, at its meeting on April 26, 1960, approved the recommendations of the Medals Committee that the following honors be given for 1960:

ASME George Westinghouse Gold Medal to Ernest Charles Gaston, Mem. ASME, president, Executive Division, Southern Services, Inc., Birmingham, Ala.

Timoshenko Medal, Cornelis B. Biezeno of Delft, Holland, and Richard Grammel of Stuttgart, Germany.

Machine Design Medal, Rudolph Earl Peterson, Fellow ASME, Pittsburgh, Pa.

Worcester Reed Warner Medal, Lloyd Hamilton Donnell, Mem. ASME, Chicago, Ill.

Melville Medal, William Godfrey Steltz, Assoc. Mem. ASME, Lester, Pa.

Prime Movers Committee Award, Sigmund N. Fiala, Mem. ASME, New York, N. Y.; and James H. Harlow, Mem. ASME, Philadelphia, Pa.

Authors of Principal Supporting Papers: (*a*) C. W. Elston, Mem. ASME; and R. Sheppard, Mem. ASME.

(*b*) W. H. Rowand, Mem. ASME; and A. M. Frendberg, Mem. ASME.

(*c*) C. B. Campbell, Fellow ASME; C. C. Franck, Sr., Fellow ASME; and J. C. Spahr, Mem. ASME.

(*d*) R. C. Ulmer, Mem. ASME; H. A. Grabowski, Mem. ASME; and R. C. Patterson, Mem. ASME.

Blackall Machine Tool and Gage Award, B. Popper of Tel Aviv, Israel; and D. W. Pessen, Assoc. Mem. ASME, Haifa, Israel.

Junior Award, Gunnar Heskestad, Assoc. Mem. ASME; and Duane Robert Olberts, Assoc. Mem. ASME, both of Milwaukee, Wis.

Arthur L. Williston Medal and Award, Marc Fishzohn of Ithaca, N. Y.

Spirit of St. Louis Medal and Spirit of St. Louis Junior Award. Upon recommendation of the Board on Honors, the Council voted to authorize the modification of the rules governing these honors to read:

(*a*) "The Spirit of St. Louis Medal shall be awarded at the discretion of the Council of the Society and may be conferred annually, if warranted."

(*b*) "The Spirit of St. Louis Junior Award shall be made at the discretion of the Council of the Society and may be conferred annually, if warranted, but only in conjunction with the Spirit of St. Louis Medal."

Research Executive Committee. *Supplement No. 2 to Research Agreement 84-1.* In accordance with the Delegation of Authority given to the Board on Technology by the Council on Nov. 30, 1959, and with the approval of the Research Executive Committee, the Secretary signed Supplement No. 2 to Research Agreement 84-1 with California Institute of Technology extending the period until Nov. 3, 1960, and providing for an increase of $15,000 ($125,000).

Professional Practice Committee. *Manual on "Recruiting Practices and Procedures—1959."* The Professional Practice Committee, at its Meeting on March 3, 1960, approved the manual on "Recruiting Practices and Procedures—1959" prepared under the auspices of the American Society of Engineering Education.

Sections. *Gulf Coast Section.* The Council, upon recommendation of Vice-President Little, Region IV, authorized the formation of the Gulf Coast Section with headquarters at Mobile, Ala., and the territory to be constituted of the area south of and including the following counties: In Alabama, Washington, Clark, Monroe, Butler, Crenshaw, Pike, Barbour; and in Mississippi, Adams, Franklin, Lincoln, Lawrence, Jefferson, Covington, Jones, Wayne.

Member Gifts Campaign. *Report.* Staff reported that as of April 29, 1960, ASME had reached 84.5 per cent of its quota. A gain of only one per cent for each of the past two months has been disappointing. Only 22 of the 92 Sections have exceeded their quotas. All Section representatives at the eight Regional Administrative Committee meetings held this spring were urged by their respective Vice-President to utilize personal calls to complete their quotas as quickly as possible. There was general agreement throughout the country to finish the task now.

The Special Gifts Campaign, under the personal direction of the President, is progressing. Confidence was expressed that this special effort would begin to show returns in the immediate future.

Engineers Joint Council. *Report.* V. W. Smith reported on the Board of Directors of EJC on April 22, 1960. Among the important items was the acceptance of the Report of the Engineers Registration

Report of Tellers

Ballot for Amendments to the Constitution

BALLOT closing May 17, 1960, noon, Tellers Amendments to Constitution, H. H. Johnson, E. A. Selma, and William Vopat report as follows

Total Valid Ballots	17,680
Defective Ballots	109
Total Ballots Cast	17,789

	Votes For	Votes Against	Not Voting
1 Change in Qualifications for Associate Member Grade (Modification of Article C4, Sec. 5)	16,049	1,580	51
2 Change in Qualifications for Affiliate Grade (Modification of Article C4, Sec. 6)	16,491	1,141	48
3 Increase in Council Personnel (Modification of Article C6, Sec. 2)	17,200	417	63
4 Change in Name of Annual and Semi-Annual Meetings (Modifications of Article C6, Sections 4 and 5, Article C9, Sections 1, 2, 4)	17,157	459	64
5 Council Quorum Increase from Eight to a Simple Majority (Modification of Article C6, Sec. 4)	17,127	495	58
6 Change from Twelve Members of the Council to a Simple Majority of the Council on Report Verifications (Modification of Article C6, Sec. 5)	17,162	484	34

Committee with the resulting authorization of the Executive Committee to consider and act on the recommendation that the National Science Foundation sponsor an initial comprehensive survey in cooperation with engineering societies to reveal accurately characteristics of the engineering profession as it exists today, through the current EJC-ECPD Survey of the Profession Committee or through a reconstituted group.

A policy for future Nuclear Congresses was adopted whereby EJC will hold Nuclear Congresses and exhibits only in alternate years. The next Congress will be in 1962 in New York City. The EJC Committee will continue to work toward reaching satisfactory arrangements with the American Nuclear Society and other organizations.

It was also reported that the ASCE policy statement on "Relationship Between Public and Private Engineering Services in Government Agencies" was accepted and authorization given to the Executive Committee of EJC to make such modifications as may be necessary following final action by the Executive Committee of ASCE.

Sterling Forest. *Meeting Facilities.* The Council approved Sterling Forest Scientific Research Center as an official center for special meetings of the ASME.

Certificates of Award. Certificates of award were prepared for John Boyd, chairman, and Brandon G. Rightmire, secretary of the Research Committee on Lubrication.

Retired Professional Division Chairman for whom a certificate of award was prepared is Oran H. Moore of the Oil and Gas Power Division.

Certificates of award have been prepared for the following Section Member Gifts Committee Chairmen whose Section attained 100 per cent of their quota: Donald E. Blue, Central Indiana, and Arthur W. Vonderharr, Central Iowa.

Retiring Section Chairmen for whom certificates of award have been prepared include the following: B. G. Barr, Kansas City; Edward W. Randall, Worcester: Myrin I. Lundin, East Tennessee; W. Craig Millis, North Texas; Kenneth T. Knight, Eastern North Carolina; Arthur Croll, Central Savannah River Area; Albert S. Beam, Detroit; George E. Shimp, Cleveland; and E. W. Cummings, Saginaw Valley Subsection.

Appointments. *Presidential.* (*a*) Honorary Vice-Presidents to represent the Society:

H. B. Nottage, April 19, 1960, Intersociety Liaison Committee of the National Research Council, Los Angeles, Calif.

F. R. O'Brien, May 14, 1960, Inauguration of President, The University of Tennessee, Knoxville, Tenn.

F. B. Turck, June 1–4, 1960, Vienna, Austria, 100th Anniversary of the Austrian Architects, Consulting and Civil Engineers.

H. D. Harkins, June 5–9, 1960, World Power Conference, Madrid, Spain.

N. D. Mochel, June 23–24, 1960, Düsseldorf, Germany, German International Meeting on Long-Time Creep Rupture Behavior of High-Temperature Alloys.

(*b*) D. E. Marlowe, Advisory Committee on Unity, to fill vacancy created by the expiration of E. W. Allardt's term as Vice-President of the Society.

ENGINEERING SOCIETIES PERSONNEL SERVICE, INC
[Agency]

THESE items are listings of the Engineering Societies Personnel Service, Inc. This Service, which co-operates with the national societies of Civil, Electrical, Mechanical, and Mining, Metallurgical and Petroleum Engineers, is available to all engineers, members or nonmembers, and is run on a nonprofit basis.

If you are interested in any of these listings, and are not registered, you may apply by letter or résumé and mail to the office nearest your place of residence, with the understanding that should you secure a position as a result of these listings you will pay the regular employment fee of 60 per cent of the first month's salary if a nonmember, or 50 per cent if a member. Also, that you will agree to sign our placement-fee agreement which will be mailed to you immediately, by our office, after receiving your application. In sending applications be sure to list the key and job number.

When making application for a position include eight cents in stamps for forwarding application to the employer and for returning when possible.

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Men Available

Chicago Office

Works Manager, Director of Industrial Engineering, Budget Director, BSEE, PE; 54; 25 years' private and professional experience increasing production, reducing costs through organization, key man recruiting and training, improving labor relations, budgetary and production control, methods and time standards, standard costs, etc., large and small plants. Location immaterial. Me-1053-Chicago.

Product or Program Director, MSME; 49; problem solving and policy-making contributions in technical market research and new products with management, development, design and research responsibility, including new product feasibility and market analysis, styling, vehicular materials handling, noise suppression, appliances, cabinetry, industrial and aircraft mechanisms and plumbing, internal-combustion power, plants, labs, and food processing. Over 23 years broad and adaptable interests. Available immediately. Location immaterial. Me-1101-Chicago.

Design Engineer, BSME; 24; three years' diversified experience in machine design, hydraulics, and high-speed machinery. $10,000. Midwest or West. Me-1104-Chicago.

Development Engineer or Chief Draftsman, some college; 33; 13 years' experience, nine on the supervisory level, in design, development, and installation of special automatic machinery, including complete electric, pneumatic, and hydraulic control systems. Salary open. Southwest. Me-1113-Chicago.

Design or Development Engineer, BME; 40; total of 18 years' experience; design, development, and stress analysis of complex aircraft structural components, unusual mechanisms, and linkages. Also detail design on processing machinery and rolling mill equipment. Two years as supervisor and several as a lead engineer. $9000–$12,000. Anywhere in U. S. A. except Southeast. Me-1114-Chicago.

New York Office

Electromechanical Component and Subsystem Development Engineer, BME, MSME, MSE; 5 years' experience in analysis and development of precision components and subsystems for use in inertial navigation equipment. Project responsibility. $12,000. Prefers Long Island, N. Y., area. Me-831.

Works Manager or Plant Manager, BS(ME); 15 years' experience in many phases of plant operation: plant maintenance, construction, tooling, methods and production. $15,000. Prefers Southwest, South, East. Me-832.

Instructor in Engineering or R&D Engineer, BSME; one year development IC engines; one year instructor. Teaching, $450 a month; other, $550 a month. Prefers East but will consider other locations. Me-833.

Service Engineer, BSME, MEd; 30 years' management and service engineering activities including director of training and director of personnel. $13,000, plus. Prefers N. J. Me-834.

Management Engineer, Mar.E; 40; 17 years' engineering experience; three as submarine engineer officer; five in HVAC; five in construction; two as engineer technical writer; two as power-plant management engineer. Graduate York and Carrier HVAC. U. S. or overseas. Me-835.

Plant or Project Engineer, BSME;[1] over ten years' experience with three years plant engineer on design, estimating, construction, maintenance for forge and pipe company; seven years design, installation, industrial plumbing, heating, and piping. $10,800. Prefers N. Y. area. Me-836.

Plant Superintendent, experienced in all phases plant operation including powerhouse, safety, union negotiations with 275 men, design, new processing, and construction. $10,000. Eastern U. S. Me-837.

Research, Development, Sales Engineer, BSME; 31; eight years' varied experience as analytical research engineer and experimental laboratory research and test engineer. Strong background in solution of problems concerning fluid flow, thermodynamics, and heat transfer; obtained with major manufacturer of central station power boilers. Ability to evaluate experimental and test results and translate into useful profitable form. Experienced in supervision and technical direction of a group. Also

[1] All men listed hold some form of ASME membership.

interested in sales engineering position. $10,000 minimum. Prefers Northeast or West Coast. Me-838.

San Francisco Office

Industrial, Production Engineer, ME, 39. Seven years' experience on design, development, and production planning on rocket, ramjet engines, and communication-equipment manufacture. One year operate and maintain milk-evaporating plant. $6000. Prefers West Coast or Chicago. Home: Calif. Se-1603.

Research and Development, 38. Ten years project engineer of complete weapon system from concept to prototype. Prepared schedules, budgets, reports, ferreted trouble areas, maintained liaison, cost control, procurement, and research and development contracts, supervised test facilities, company representative; creatively inclined. Salary open. Prefers Far West, San Francisco Bay area. Home: Utah. Se-1590.

Designer, Estimator or Sales, ME, 28. Five months estimating, take-off on steam-power station for construction company; 17 months installation of engines, missile system studies for aircraft manufacturer. $6300. Prefers San Francisco Bay area. Home: San Francisco. Se-1552.

Research and Development, ME, 29. Five years applied mechanics research, heavy vehicles, emphasis on high-strength steel, gearing, fatigue, stress, mechanical analysis, machine-element design. Also three months power and industrial machinery orientation and three months furnace brazing research for rocket engine alloys. $8400–$9600. Prefers San Francisco Bay area, East Coast. Home: Calif. Se-1538.

Maintenance Engineer, ME, 35. Seven years' experience in maintenance of chemical plant. Familiar with all types of heavy process equipment; knows preventive maintenance procedures, cost control, design, coatings, experienced supervisor. $9000. Prefers Calif., West. Home: Calif. Se-1528.

Sales Engineer or Personnel, ME, 37. Interested primarily in personnel, sales engineering, or maintenance. Twelve years' varied experience selling and servicing mechanical and electric products to mining, chemical, utility, and pulp and paper industries. Also experienced in personnel. $8400. Any location. Home: Wash. Se-1517.

Chief Designer, BSME, MSEE, Chem, 48; 22 years' experience, in charge of design, engineering, research, installation, negotiations on aluminum and magnesium production and processing, explosives manufacture, contractors on government projects, and refinery facilities. $10,000. Any location. Home: Wash. Se-1515.

Construction Superintendent, ME, 38; 14 years' experience on contract negotiation, promotion, estimates, construction for general contractors. $12,000. Prefers San Francisco Bay area. Home: Calif. Se-1493.

Manager or Industrial Engineer, IE, 36; ten years' experience in top management. Previously associated with firm in metal industry. Completely conversant with production, sales, labor relations, and engineering. Have installed industrial-engineering problems. $10,000–$12,000. Prefers San Francisco Bay area. Home: Calif. Se-1467.

Specification Engineer, Co-ordinator, ME, MBA, 31. One year experience in each: Specification engineer for construction and instrumentation for contractors; plan and schedule for petroleum refinery; industrial engineering for tape recorder manufacturer; controlled budget for electronics defense company. $7800. Prefers San Francisco or any. Home: Calif. Se-1464.

Research and Development, Design, ME, 40 Licensed ME in Calif.; 18 years' administrative activities in engineering research and development, organizing, and designing aero and space research and aircraft manufacture. $15,000. Prefers West Coast or any. Home: Calif. Se-1455.

Production Management, IE and Mgmt, 54. Qualified to take complete charge of manufacturing plant or head up manufacturing division of major organization. Extensive experience in methods, tooling, manufacturing, assemblies, and quality control. Skilled trouble shooter, able to handle any shop problem. Salary open. Any location. Home: Calif. Se-1440.

Utility Superintendent, ME, 37. Ten years' operational and start-up experience in all phases of utility areas; steam, water, refrigeration, plant air, electric. $9600. Prefers Calif., Ariz. Home: N. Y. Se-1383.

Chief Engineer, Development, ME, 42; 20 years' broad experience at progressively higher

Keep Your ASME Records Up to Date

The ASME Secretary's Office depends on a master membership file to maintain contact with individual members. This file is referred to countless times every day as a source of information important to the Society and to the members involved. All other Society records are kept up to date by incorporating in them changes made in the master file.

The master file also indicates the Professional Divisions in which members have expressed an interest. Many Divisions issue newsletters, notices of conferences or meetings, and other material. You may express an interest in the Divisions (no more than three) from which you wish to receive any such information which might be published.

Your membership card includes key letters, below the designation of your grade of membership and year of election, which indicate the Divisions in which you have expressed an interest. Consult the form on this page for the Divisions to which these letters pertain. If you should wish to change the Divisions you have previously indicated, please so notify the Secretary.

It is highly important to you and to the Society to be certain that our master file indicates your current mailing address, business or professional-affiliation address, and interests in up to three Professional Divisions.

Please complete the form, being sure to check whether you wish mail sent to your residence or office address, and mail it to ASME, 29 West 39th Street, New York 18, New York.

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LAST NAME _____ FIRST NAME _____ MIDDLE NAME _____

POSITION TITLE _____ NATURE OF WORK DONE _____

e.g., Design Engineer, Supt. of Construction, Manager in Charge of Sales, etc.

NAME OF EMPLOYER (Give name in full) _____ Division, if any _____

*☐

EMPLOYER'S ADDRESS _____ City _____ Zone _____ State _____

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- ☐ *Journal of Applied Mechanics*
- ☐ *Applied Mechanics Reviews* — 1st of preceding month

Professional Divisions in which I am interested (no more than *three*) are marked X.

- ☐ A—Aviation
- ☐ B—Applied Mechanics
- ☐ C—Management
- ☐ D—Materials Handling
- ☐ E—Oil and Gas Power
- ☐ F—Fuels
- ☐ G—Safety
- ☐ H—Hydraulics
- ☐ I—Human Factors Group
- ☐ J—Metals Engineering
- ☐ K—Heat Transfer
- ☐ L—Process Industries
- ☐ M—Production Engineering
- ☐ N—Machine Design
- ☐ O—Lubrication
- ☐ P—Petroleum
- ☐ Q—Nuclear Engineering
- ☐ R—Railroad
- ☐ S—Power
- ☐ T—Textile
- ☐ U—Maintenance and Plant Engineering
- ☐ V—Gas Turbine Power
- ☐ W—Wood Industries
- ☐ Y—Rubber and Plastics
- ☐ Z—Instruments and Regulators

Additional listings of positions and men available are maintained in the offices of E.S.P.S. Direct inquiries to nearest office. A weekly bulletin of engineering positions open is available at a subscription rate of $3.50 per quarter or $12 per annum for members; $4.50 per quarter or $14 per annum for nonmembers, payable in advance.

levels. Successfully developed process and equipment for profitable facilities expansion. Experienced in management, development, design, fabrication, start-up, and evaluation of complex, high-productivity, precision equipment. $19,000. Prefers San Francisco Bay area. Home: East. Se-189.

Positions Available

Chicago Office

Mechanical Designer, graduate mechanical, at least five years' experience with consultant on mechanical powerplant and piping design. Will check manufacturers' drawings, make layouts, etc., on mechanical phases of power-plant design for a consultant. $8100–$9000 a year. Employer will pay placement fee. Chicago, Ill. C-8134.

Engineers. (a) Director of engineering design, mechanical engineer with chemical experience, or chemical engineer, to 50, at least five years' experience as chief engineer or managing engineer on design of chemical plants. Will be responsible for group of chemical-process engineers in complete charge of over-all design of chemical plants. About $15,000. (b) Chief draftsman, to 50, to take charge of drafting room with about 75 employees. Prefer registered engineer, strong mechanical or structural; 80 per cent of work related to chemical-process industry; 20 per cent to general building structures, etc. Position with a firm of engineers and constructors. $10,000–$15,000, depending upon experience. Employer will pay placement fees. Chicago, Ill. C-8131.

Chief Manufacturing Engineer, graduate, to handle administrative duties of engineering, tool and pattern design, process and methods determination, time study, and toolroom function. A total of 60 people will report through five general supervisors. Company has a drop forge, foundry, general machining, and assembly of large equipment. $12,000–$18,000, depending upon experience. Southern Wis. C-8123.

Mechanical Engineers. (a) Chief project engineer, graduate, at least five years' experience in basic tractor design diesel and gasoline engines. Knowledge of machine-design power-transmission systems, related electrical and hydraulic equipment manufacturing methods, materials, heat-treatment, processing, and finishes. Will be responsible for development of an entire new line of agricultural tractors. Will supervise from five to 15 engineers. Must be creative. Open, depending on experience. (b) Staff engineer, engine specialist, graduate, at least eight years' experience on gasoline and/or industrial tractors or comparable mobile equipment. Experience should include five years on design supervision on engine installations. Open depending upon experience. Employer may negotiate fees. Mich. C-8118.

New York Office

Sales Engineer, graduate mechanical or electrical, three to five years' sales experience representing a technical product. Familiarity with hydraulics, controls, electronics, servos highly desirable. Recent contacts in aircraft, missiles, or control fields also desirable. In-plant training prior to territory assignment. Travel three days per week. Apply by letter giving complete data, including present and expected salary. Company pays placement fee, relocation, and interviewing expenses. Headquarters, Upstate N. Y. W-9120.

Plant Engineer, graduate mechanical, at least five years' practical experience; should be familiar with construction trades, process-industry equipment, and engineering department systems including drawings, specifications, purchasing, and supervision. Position with small chemical plant. Excellent opportunity. Eastern Pa. W-9118.

Sales Manager for company processing a manufactured insulating material especially for pipe-covering insulation. Should have experience in low-temperature insulation field. $12,000–$15-000. Headquarters, Upstate N. Y. W-9116.

Construction Engineer, graduate mechanical, eight to ten years' experience in project engineering of heavy chemical or petrochemical plants. Will co-ordinate construction projects between project engineering and field construction. Follow job through engineering and purchasing phases and make preparation for construction phases of job. Perform liaison engineering functions between construction superintendents and project engineering. To $10,000. Company pays placement fee. New York, N. Y. W-9112.

Design Engineer, Vessels, graduate mechanical, five to eight years' experience, to design shape, size internal and external requirements of vessels such as towers, storage tanks, distillation columns, reactors, and drums, pressure and nonpressure types. Originate new design and approve drawings. To $10,000 a year. Company pays placement fee. New York, N. Y. W-9111(a).

Sales Engineer, mechanical or electrical graduate preferred, three or more years' of sales engineering experience in the capital equipment field, for the sale of customized semiautomatic and automatic strapping machinery throughout the U. S.; 50 per cent travel. To $10,000. Headquarters, Ill. W-9110.

Engineers. (a) Plant project engineers, graduate mechanical, experience in plastics, resins, and adhesives; three to five years' experience, $8000–$10,000; five to ten years', $10,000–$12,000. (b) Supervisory industrial engineer, 10 years' experience as afore-mentioned, or similar operations, five years of which have been in supervisory capacity. $10,000–$12,000. Conn. W-9104.

Plant Manager for a new sewing plant; preferably with garment industry experience. Should be familiar with the problems of machine maintenance; principles of operator training and time and motion study, etc. Must be able to handle plant layout. To start, $10,000–$12,000. South. W-9101.

Instructor for Engineering Mechanics Faculty; MS degree required, with PhD preferred, to teach undergraduate work in statics and dynamics, strength of materials, fluid mechanics, vibrations, or materials testing lab. Graduate program in college of engineering being developed; if qualified would be assigned to teach graduate work in afore-mentioned subjects. Salary and rank based on qualifications. Midwest. W-9094

Mechanical Design Engineer, experience in machine paper converting die design and machine research and development on printing, laminating, slitting, and cup machinery. Will investigate machinery for new products and purchase equipment. To $10,000. Vt. W-9091.

Vice-President—General Manager to head up a team to organize the management and administration of a government-owned mining operation. Mining experience not required but must have experience in investment and corporation management. $25,000, plus or minus. Mediterranean area. F-9083.

Mechanical Engineer, Chief of Quality-Control Section, graduate, experience in both mechanical and electrical quality control. Will be responsible for setting up and administering complete quality-control system and will answer directly to vice-president in charge of engineering. Agency fees, relocation expenses, etc., open to negotiation. Salaries open. Upstate N. Y. W-9080.

Industrial Engineer to head up a new multitextile plant industrial engineering department; any experience in wide woven and knitted fabrics desirable. $12,000–$15,000. Northern N. J. although initially R. I. W-9074.

Paper-Conversion Chief to organize, supervise, and be responsible for conversion. Experience in sheeting, bag production, bond and gum tape. Facial tissue conversion experience desirable. Salary open; housing, electricity, etc., furnished. Peru, S. A. F-9059.

Production Planning and Control Manager who has been responsible for the production planning and control function in an organization of 2500 employees or larger. Must have a background in data-processing systems and be capable of initiating a program of punched card control. Will be top man in the material-control function and will report directly to the manager of manufacturing. About $15,000. Placement fee negotiable. N. J. W-9049.

Engineers. (a) Production manager, graduate, to take charge of all scheduling (IBM), inventory-control stock room, routing of job-shop-type machine shop and assembly of medium-sized machinery. $12,000–$13,000. (b) Chief industrial engineer, graduate, five to ten years' experience in time study, methods, wage incentive, manufacturing engineering for machine shop. $12,000–$13,000. (c) Manufacturing engineer for job machine shop and special machinery builders. Mass. W-9031.

Industrial Engineer, graduate IE or ME, two to five years' shop experience in methods, standards, layout, etc. for company manufacturing molded and laminated plastics. $8500, plus or minus. Company pays placement fee. Eastern Pa. W-9026(a).

Production Engineer, graduate mechanical, preferably some experience in paper manufacturing, especially in the converting end, for a manufacturer of paper and paper products such as ream tissue, napkins, towels, waxed paper, etc. Excellent opportunity. Open. Upstate N. Y. W-9021.

Industrial Engineer, 35-45, five years' experience handling bulk material, i.e., coal, grain, cement, etc., to make studies on elevators in different sections of the country, recommend mechanical devices, time and motion studies, cost reduction, standard procedures, etc. Travel. About $12,000. Headquarters, New York City. W-9012.

San Francisco Office

Plant Engineer, ME, 27–38, minimum two years' experience in food processing or allied industry, experienced in equipment selection and design and plant layout. Supervise new installations, prepare layouts, estimates, reports, instruct draftsmen, prepare specifications; on new equipment, plant layout, construction. Salary open. Southern Calif. Sj-5318.

Designer, ME or equivalent, 25–45 minimum three years' experience in design and drafting machinery. Knowledge of machinery materials and manufacturing processes. For design of machinery, some electrical, electronic, electropneumatic and hydraulic circuitry, under supervision of project engineer. $6000–$8400. Southern Calif. Sj-5317.

Senior Engineer, ME, minimum ten years' engineering experience, with five years' in food processing or allied industry and five years basic engineering in any other industry, 30–42. Assist in development and supervision of policies and programs on engineering, maintaining plant and processing facilities, plant and warehouse construction; assist in development of new or improved production and processing techniques to reduce present processing costs and improve existing equipment efficiency. Salary open. Southern Calif. Sj-5316.

Junior Plant Engineer, ME, two to five years' experience, 25–35, to maintain plant efficiency at minimum cost, supervise crew in installing equipment, maintenance of equipment and plant grounds, determine cost and control on repair and installation. Salary open. Southern Calif. Sj-5315.

Project Engineer, ME or ChE, three to five years' engineering experience required. Must read and speak Japanese fluently. Initial training at manufacturing facility in engineering aspects and operation of vegetable oil-processing equipment. Training will be directed toward specific understanding of equipment and processes associated with company's technical assistance program to Japan. Direct the installation of processing equipment and assist in implementation of program. Japan and San Francisco. Sj-5314.

Estimator, some college, to 40. Experienced estimator, primarily heavy-steel plate on industrial products, large fixtures, and tools. Able to do some drafting, design, and shop detailing, to take off from customers' drawings and experienced to meet and deal with clients. Desirable to know ASME Code on Pressure Vessels and desirable to have shop experience in heavy-steel-plate work for medium-sized steel fabricating shop. $9000, plus benefits. San Francisco East Bay. Sj-5310.

Plant Engineer, ME, preferred experienced on pneumatic bulk-handling systems, to install new bulk-handling systems and stay on as plant engineer, in charge of maintenance, production, general engineering duties for food-processing company. About $7500–$8000, or open, depending on experience. San Francisco East Bay. Sj-5303.

Designers, ME, with manufacturing experience. Under resident engineer, would handle all of the projects involved with equipment and machinery for can manufacturing department, as well as bulk handling of cans equipment. Central Calif. Sj-5298.

Designer, graduate, two to five years' engineering experience, one to two years' experience in electromechanical equipment design and assembly preferred. Must be able to work with hands and operate conventional shop tools. For manufacturer of high-quality stereophonic tape recorders and sound system for the consumer market. Employer will pay placement fee. $6600–$8700. San Francisco Peninsula. Sj-5297.

Systems Engineer, ME, ten to 12 years' electromechanical systems experience, preferably in high fidelity equipment. Must be able to work with hands and operate conventional shop tools. Administrative ability required. Employer will pay fee. For manufacturer of high quality stereophonic tape recorders and sound systems. $8400–$11,100. San Francisco Peninsula. Sj-5295.

Sales Engineer, ME, under 50. Well-experienced in complete line of pumps (turbine, boiler feed, chemical industry, deep well); able to take over a developed territory and be responsible for direct sales to users (factory, cannery, buildings, municipalities) of pumps, units, and parts. For manufacturer's representative. Base salary plus expenses, car allowance and earned incentive.

Car required. San Francisco East Bay. Sj-5292-R.

Instrumentation Supervisor, graduate or equivalent experience, some electrical background desirable, to 45. Previous mill experience not essential, but desirable. Must be familiar with pneumatic instruments (few are electronic), know installation and operation on boiler feedwater control. Able to make own calculations for orifice flow meters, capable of requisitioning, installing, and maintaining instruments. Housing available. $7800–$8400, depending on background. For uranium milling operations. N. Mex. Sj-5288.

Manufacturing Engineer, ME or EE, young. Two to five years' working experience relating to quality control, manufacturing, specifications, liaison with production, research, design, and production. Will be concerned with technical phases of construction and manufacturing of electrical power cable (fabrication, stranding, insulation, gas, oil, vacuum, metal, protection). Company will provide training program. Salary commensurate with experience. For national manufacturer. San Francisco Bay area. Sj-5287.

Designers, Seniors and Assistants, graduates, recent graduates to senior staff level, to 35. Sixty electronic positions and ten mechanical. Informed in UHF, VHF, S-band, logic circuits, microwave, radar digital, and counter measures on navigation, guidance, process and control systems for development of long-range height finder, situation display, simulators, traffic controls, vulnerability studies. For research and development of a manufacturer. $7000–$15,600. U. S. citizens. Employer pays fee and relocation cost. Southern Calif. Sj-5286.

Mining, Civil, or Mechanical Engineer, minimum three years' experience, prefer more in design, computation, and layouts on structural steel and heavy equipment used in open pit and underground mining and milling plants. Must be familiar with typical mine and mill-plant engineering-type operation and able to furnish advice and recommendation on structural elements for installing new equipment and revamping existing plant. $7200–$7800. Idaho. Sj-5283-R.

CANDIDATES FOR MEMBERSHIP AND TRANSFER IN ASME

THE application of each of the candidates listed below is to be voted on after July 25, 1960, provided no objection thereto is made before that date and provided satisfactory replies have been received from the required number of references. Any member who has either comments or objections should write to the Secretary of The American Society of Mechanical Engineers immediately.

New Applications and Transfers

Alabama

BLACK, C. D., Florence
HENDRICKS, WALTER G., JR., Birmingham
WILLIAMS, LEWIS W., JR., Birmingham

Arkansas

●JEFFERSON, THOMAS B., Fayetteville

California

ABBOTT, RICHARD G., Los Angeles
CHALUPNIK, JAMES D., Palo Alto
●IANNI, PIO W., San Jose
LEONIAN, ARMEN L., Belmont
●LIBBEY, SCOTT, JR., Pacific Palisades
MARKLING, WILLIAM P., Inglewood
READ, JOSEPH R., La Mirada
SUVERKROP, DON, Bakersfield
THORNE, CHARLES J., China Lake
VAN SANT, JAMES H., JR., San Diego
VICK, JEROME H., San Diego

Colorado

GREEN, CHARLES E., Lakewood
SHEAROUSE, JAMES D., Colorado Springs
SMITH, MARINE L., Denver

Connecticut

HSIEH, JUI S., Bridgeport
JUDD, JOHN E., New Haven
●WILSON, HARRELL M., W. Hartford

Delaware

HUDE, KARL V., Wilmington

District of Columbia

RAMRAKHIANI, DINDAYAL J., Washington
RICH, LUCIEN L., Washington

Florida

BLACKWELL, PAUL K., Miami
CRUMP, JOHN M., Jacksonville
KOSSUTH, GABOR, Tampa
LAWRENCE, WILLIAM A., Miami
SHEPPARD, WILLIAM N., Pensacola
STRALEY, DEWEY E., Miami
STREET, HARRY V., Miami
STUMPE, ANTHONY W., Miami
TILTON, EDWIN J., JR., Coral Gables
WERRY, BENJAMIN H., Miami

Georgia

HALL, DAWSON J., Atlanta
STANFORD, BILLIE P., Savannah

Illinois

CHANEY, LUCIEN A., Decatur
DAVIES, EVERETT H., Rockford
●HEIMANN, WERNER, Chicago
KORSMO, ROBERT F., Moline

●Transfer to Member or Affiliate.

Indiana

BAKER, EDWIN L., Indianapolis
PERRY, JAMES L., Indianapolis

Kansas

●HENDON, JAMES B., Prairie Village
RUMSEY, DONALD G., Missions
TOWNLEY, LELAND O., Topeka

Louisiana

●DECKER, ARTHUR L., Baton Rouge

Maine

HILL, RICHARD C., Orono

Maryland

CRUSH, ROBERT G., Baltimore
●DIXON, LEWIS C., Mount Airy
GAY, HERMAN P., Aberdeen
●HUFFINGTON, NORRIS J., JR., Timonium

Massachusetts

CHEN, SHAW-DONG, Cambridge
GILVAR, MARTIN, North Grafton

Michigan

●ANDERSON, ROBERT H., St. Clair Shores
SALONIMER, JOSEPH R., Warren
WRIGHT, JOHN G., Allen Park

Minnesota

FRAWLEY, VINCENT A., Minneapolis

Mississippi

WISLOCKI, JOSEPH P., Vicksburg

Missouri

CLARK, F. GORDON, Kansas City
JANES, FRANK E., Kansas City
PORTER, JAMES C., New Haven
ROEHRS, O. AUBREY, St. Louis

Nebraska

FRANCIS, BYRON E., Omaha

New Jersey

DANFORD, MARVIN D., Moonachie
DERNER, WILLIAM J., Wyckoff
OTTEAU, HENRI J., JR., Nutley
VESPASIANO, LOUIS A., Newark

New York

BABYOK, PAUL E., Olean
BAUSCH, WILLIAM G., Rochester
BOUDRIE, WARREN E., Schenectady
CHILAZI, ZAKARIA E., Buffalo
COUPE, GORDON M., Syracuse
CURWEN, PETER W., Ballston Spa
DOHRMANN, HENRY C., New York
●DYKMAN, MILTON, Rochester
FRENCH, EDWARD H., New York
GLITTENBERG, EUGENE O., Scarsdale
GOTTDENKER, ALLAN J., Brooklyn
HINDENLANG, ARTHUR W., New York
KISS, EDWARD, Schenectady
●LIPP, GEORGE D., Corning
●MARSH, WILBUR D., Schenectady
MCPHILLIAMY, JAMES R., Woodhaven
ODLIVAK, MICHAEL, Astoria
STEELE, FINLEY M., Elmira
WOLFF, JONAS, Schenectady

North Carolina

DAVIS, PAUL S., Grover

Ohio

DEVILLERS, GERALD E., Columbus
●HUMMELL, JOHN D., Columbus
KIDWELL, JOHN H., Canton
O'KANE, RUSSELL C., Columbus
RICCARDI, ANTONIO, Barberton
ROGERS, WILLIAM J., Akron
THORSON, NORMAN P., Cincinnati
VIERTEL, RICHARD K., Cincinnati

Pennsylvania

●BURKE, CHARLES J., Springfield
●CLARK, CHARLES C., Erie
DUGAN, FRED B., Philadelphia
HANNIS, EUGENE S., Philadelphia
HEADINGTON, EDWARD E., State College
IRWIN, JOHN W., Lewistown
LAVANCHY, ANDRE C., Wayne
●LUDDY, CHARLES T., Erie
NEWBERY, LESLIE A., Pittsburgh
PRICE, BENJAMIN F., Springfield
●RANDMAN, JEROME M., Pittsburgh
●SPRINGER, EVERETT W., Johnstown
STROHMEYER, CHARLES, JR., Reading
WAITE, MALCOM W., Erie

Rhode Island

●DEPUY, FRANCIS A., E. Greenwich

South Carolina

●EDWARDS, JAMES L., Clemson
MIMS, JAMES A., SR., Hartsville
YON, JAMES H., JR., Hartsville

Tennessee

●KUREK, JOHN, JR., Chattanooga
SWINGLE, EVERETT T., Chattanooga

Texas

BEDSOLE, JOHN O., Port Arthur
CARSON, ALAN B., Odessa
●NOVOSAD, THOMAS L., Houston
SHOFFSTALL, ROBERT J., Garland

Utah

HOUMAN, LEIF, Salt Lake City

Virginia

BERRY, PHIL H., JR., Norfolk
BONNER, TOM F., JR., Hampton
MORSE, ROBERT F., Richmond
RISTEEN, WILLIAM H., Fairfax

Washington

●PETERSON, ROY S., Richland

Wisconsin

PAVELIC, VJEKOSLAV, West Allis

Foreign

BHINDER, FATEH S., Southall, Middlesex, U. K.
BORG, CHARLES P., Deep River, N. Renfrew, Ont., Can.
CHAKRABARTI, RAJAT K., Calcutta, India
LEONE, JOHN A., Maracaibo, Venezuela
MATEN, STEFFEN, Fort. St. John, B. C., Canada
PEDRAZA, GABRIEL A., Bogota, Colombia, S.A.
PRASAD, RAM, Ambarnath, Bombay, India
SWARTMAN, ROBERT K., Kingston, Ont., Canada
●TOVEY, HAROLD C., W. Essendon, Victoria, Australia
WEBB, COLIN J. E., Forest Reserve, Trinidad, B.W.I.
WIECKOWSKI, JERZY T., Toronto, Ont., Canada

OBITUARIES

Nelson Walter Burtt (1901–1959), engineer, Product Sales Div., The Foxboro Co., Foxboro, Mass., died Sept. 4, 1959. Born, Lowell, Mass., Oct. 4, 1901. Parents, Frederick Kittredge and Mary Alice (Nelson) Burtt. Education, SB, M.I.T., 1923. Married Helen Maxine Long, 1927; son, William Holbrook. Before joining the Foxboro Co., makers of industrial instruments, in 1940, Mr. Burtt was draftsman and junior engineer for Stone & Webster, Boston, Mass., in 1924; engineer with John A. Stevens, Inc., Consulting Engineer, Lowell, Mass., from 1925 to 1929; and designer and project engineer in charge of plant and equipment for rayon, nylon, and cellophane processes for DuPont Rayon Co., Buffalo, N. Y., from 1929 to 1940. A hobby led to his writing articles on modelmaking of steam locomotives published in *Modelmaker*, Nov., 1939. He was co-author of a critical survey of 1941 motorcars for *Consumer Digest*, Dec., 1940.

Registered professional engineer in the State of New York. Jun. ASME, 1923; Assoc-Mem. ASME, 1933; Mem. ASME, 1935.

Frank Dana Carvin (1892–1960), retired director of mechanical engineering at Illinois Institute of Technology and a consulting engineer, died, Summit, N. J., March 25, 1960. Born, Philadelphia, Pa., Nov. 16, 1892. Parents, Frank and Minnie Dana (Johnson) Carvin. Education, BS(ME), Univ. of Pennsylvania, 1916; ME, 1924; MA, Columbia Univ., 1930; PhD, New York Univ., 1938. Married Caroline Cathrine Snyder, 1917. Dr. Carvin had a distinguished career as an educator which he began in 1919 as instructor of mechanical engineering at the Univ. of Pennsylvania. From 1924 to 1934 he was professor of heat power and design at Polytechnic Institute of Brooklyn. He was professor and head of the department of mechanical engineering at Newark College of Engineering from 1934 to 1948. He was also chairman of the graduate division in his last two years at NCE. A registered professional engineer in the States of Illinois, New York, and New Jersey, he engaged in consulting work until his death. Dr. Carvin authored many technical articles published in trade and engineering publications and wrote a text on "Propulsion of Land, Air, and Water Vehicles." For many years he held an active pilot's license and served as co-ordinator of civil pilot training for the Civil Aeronautics Board from 1939 to 1945. During World War II, he acted as consultant for the War Department. Mem. ASME, 1930; Fellow ASME, 1958. He was a member of ASME Metropolitan Section Executive Committee from 1939 to 1943 and served as chairman in 1941. From 1953 to 1956, he was a member of the Executive Committee of the Chicago Section as well as the Illinois Engineering Council. He was a member also of the Radio Broadcast Committee, the Industrial Salvage Committee of the War Production Board, the War Production Board Clinic, the Veterans Policy Committee, and ASME representative to the Council of AAAS. He was active in SAE and ASEE, and a fellow of AAAS, serving as secretary of Section M—Engineering. Member, also, New Jersey State Department of Labor, Sigma Tau, Tau Beta Phi, and Pi Tau Sigma. Surviving are his wife; two brothers, Earl W. and Russell T. Carvin; and a sister, Mrs. Bessie Crouse.

Paul Burns Eaton (1888–1960), emeritus-professor of mechanical engineering at Lafayette College, Easton, Pa., died at Easton Hospital April 5, 1960. Born, Scranton, Pa., May 31, 1888. Parents, Herbert H. and Minnie B. Eaton. Education, ME, Cornell Univ., 1911. Married Hannah Wilkins, 1925; one son, John Paul. Prof. Eaton was instructor of mechanical engineering at Cornell Univ. from 1911 to 1915. From 1915 to 1918 he was professor and head of the department of mechanical engineering at the Chinese Government Engineering College, Tangshan, China. He was awarded the Decoration of the Chia Ho of the Chinese Government for distinguished service in engineering and engineering education. After serving a year with the Steel Ship Division of the U. S. Shipping Board, Baltimore, Md., he returned to Cornell as instructor of mechanical engineering. In 1924, following a year at The Pennsylvania State College, he joined the faculty of Lafayette College and became head of the department of mechanical engineering in 1931; he retired in 1953. In addition to his teaching duties he had an extensive consulting practice. He was sent to China in 1943 as a special emissary of the U. S. Department of State and was adviser to the Ministry of Communications of the Chinese Republic. During World War II, as consultant to the Armed Forces and the Department of State, he aided in setting up the program for specialized war-training courses. He was a member of the Purdue Univ. team sent to Formosa by the Mutual Security Administration from 1953 to 1955 to investigate steps to rehabilitate a college of engineering. Prof. Eaton wrote various papers on industrial training and industrial problems of China and was co-author of the book, "Machine Design." Mem. ASME, 1922; Fellow ASME, 1949. His ASME activities included: Member of the "Old Guard" Anthracite-Lehigh Valley Section; speaker of the National Regional Delegates Conference; member of the Committee of Relations With Colleges; Manager, 1940–1942; Vice-President of Region III, 1947–1949; and Director, 1951–1953. Member, also, American Association of University Professors, Society for the Promotion of Engineering Education, Tau Beta Pi, and Pi Tau Sigma. Surviving are his wife and son.

Alexander Natanael Engblom (1885–1960), consulting engineer, Borås, Sweden, died March 30, 1960. Born, Södertälje, Sweden, Feb. 17, 1885. Education, graduated from John Lennings Textile School, Norrköping, 1906; ME, Royal University of Technology, Stockholm, 1908. An expert in the field of textiles, Mr. Engblom was mechanical superintendent at Sidney Blumenthal & Co., Textile Mills, Shelton, Conn., 1910–1917. From 1917 to 1920 he was works superintendent and efficiency expert for Lithografiska Aktiebolaget, Norrköping, Sweden. In 1920 he joined Borås Wäfveri, Aktiebolag, cotton manufacturers, becoming a director in 1926. He was president of the AB Dyestuff Chemical Corporation, Gothenburg, and AB Textilalex, Borås. Mr. Engblom laid the plans for textile education in Sweden which resulted in the Textile School in Borås. He was appointed by the Swedish government to work out plans for the Government Committee in 1940 which laid the foundation of the Swedish Textile Research Institute in Gothenburg; he became a member of its board. He was the author of various publications on technical, textile, economical, and social subjects. He received the Commander of the Royal Order of Vasa award, Knight of the Royal Order of the North Star, the French Legion of Honor, and eight gold medals for achievements in technical, industrial, and social fields. He was vice-president of the Board of the Technical Museum, Stockholm, member of the board of the Swedish Textile Employers' Association, first vice-president of the Swedish National Committee of Scientific Management, member of the board of the Swedish Institute, Stockholm, counselor of the mechanical department of the Royal Technical University, Stockholm, and counselor in the chemical department of Chalmers' Technical University, Gothenburg. Mr. Engblom was president of the Technical Society of Borås, 1925–1940. Assoc-Mem. ASME, 1914; Mem. ASME, 1935; Fellow ASME, 1938. Member, also, Royal Swedish Academy for Engineering Research, Fellow of the Textile Institute, Manchester, SAM, and American Society of Swedish Engineers.

Frederick P. Fairchild (1889–1960), chief engineer for the electrical engineering department of the Public Service Electric and Gas Co., Newark, N. J., from 1937 until his retirement last year, died in New York City, March 31, 1960. Born, Ellsworth, Kan., Jan. 28, 1889. Parents, Edward Thomson and Frances (Postlethwaite) Fairchild. Education, BS(ME), Univ. of Kansas, 1910. Married Marvel Horton, 1923. Mr. Fairchild had wide experience in the power-plant field beginning in 1910 with Allis-Chalmers Co., Milwaukee, Wis. He was later with the San Diego Consolidated Gas and Electric Co. in California; Stone & Webster, Boston; Dwight P. Robinson & Co., New York City; Ladd Water Tube Boiler Co., Pittsburgh; Combustion Engineering Corp., New York City; and United Engineers and Constructors, Inc., Philadelphia. He was an early advocate of pulverized-fuel firing and large boilers; and was recognized as one of the first to use the austenitic type of steel alloy in high-temperature, high-pressure power-plant piping and to promote its use until the entire utility industry had accepted it. He was also a proponent of the high-speed turbine generators now accepted by the power industry. He was author of many works on steam generation and equipment. In 1951 he received an honorary DE degree from the Stevens Institute of Technology. Assoc-Mem. ASME, 1915; Mem. ASME, 1926; Fellow ASME, 1951. In 1958 he received the ASME George Westinghouse Gold Medal. Mr. Fairchild was a registered professional engineer in the States of New York and Pennsylvania. He was chairman of the Prime-Movers Committee of Edison Electric Institute; a member of the committee on power generation of the Association of Edison Illuminating Companies; on the advisory committee of steam turbines of the International Electrotechnical Commission; and president of the New York Engineers' Club. Member, also, AIEE, Essex Club of Newark, and Newcomen Society of England. Surviving are a daughter, Mrs. Susan F. Sala, Hartford; a brother, Edward P.; and two sisters, Mrs. Louise F. Holden and Mrs. Frances F. Taylor.

Frank Richard Fitzpatrick (1881–1959), assistant to the chairman of the board, Combustion Engineering, Inc., New York, N. Y., died Oct. 2, 1959. Born, St. Louis, Mo., Jan. 14, 1881. Parents, Frank A. and Margaret (King) Fitzpatrick. Education, AB, Harvard Univ., 1903; attended Lawrence Scientific School for Graduate Study, 1906. Married Gertrude Barber, 1923. Mr. Fitzpatrick was employed by the Pennsylvania Railroad from 1906 to 1915. He then joined Superheater Co., New York, N. Y., and became assistant to the president. During World War I he was a captain in the U. S. Army Corps of Engineers. He wrote various articles in connection with the use of superheated steam. Mem. ASME, 1919.

William B. Hamilton (1881–1960?), died recently according to notice received by the Society. Born, Tallassee, Ala., July 2, 1881. Education, BS and MS, Alabama Polytechnic Institute, 1902. Mr. Hamilton had a long career with Hardie-Tynes Manufacturing Co., Birmingham, Ala., as draftsman and sales and production engineer. Mem. ASME, 1912.

Carl Chester Harris (1880–1960), chairman of the board, Rodney Hunt Machine Co., Orange, Mass., died April 4, 1960. Born, Orange, Mass., May 9, 1880. Parents, Nelson E. and Evie Harris. Education, BS, Worcester Polytechnic Institute 1903. Married Marion E. Felton, 1918; five children: Paul S., Garna Cumberland, Elizabeth, Earl F., and Edward S. Mr. Harris had a long career with the Rodney Hunt Machine Co., starting as assistant engineer in 1904 and becoming president in 1938. During this time he was in charge of installation of water-wheel equipments, water-controlling apparatus, concrete dams, power stations, and factory electrical equipment. He was the author of the book, "Power Development of Small Streams," and was granted more than 40 patents on mechanical equipment including a machine-tool post, a small adding machine, and a factory time-keeping device. Mem. ASME, 1914. Member, also, Boston Society of Civil Engineers.

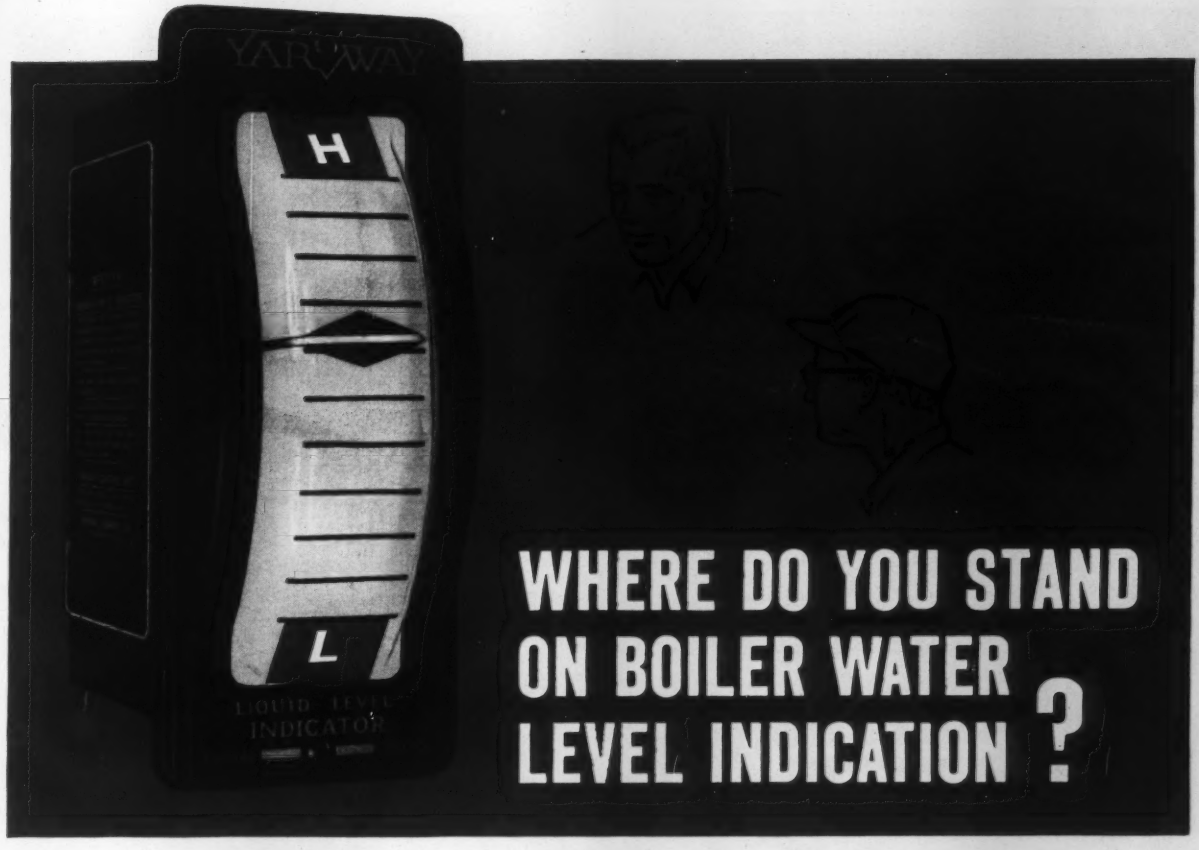
Frank Franz Jacobson (1887–1959), president, Seamlex Co., Inc., died in New York City, Nov. 30, 1959. Born, Crivitz, Germany, Jan. 11, 1887. Parents, Edward and Bertha (Seelig) Jacobson. Education, ME, Technikum Ilmenru, Germany, 1906. Married Rose Sheffield, 1928. Mr. Jacobson gained his experience in the field of railway equipment while employed by several companies in Europe. In 1913 he joined Carnegie Steel Co., Duquesne, Pa., as mechanical and structural draftsman and checker. He later was employed by Pressed Steel Car Co., McKees Rock, Pa., and their subsidiary, Koppel Industrial Car & Equipment Co., Koppel, Pa., as checker and estimator. In 1924 he became president of The F. Jacobson Engineering Co., New York City. He held a German patent on a safety stopping device for dump cars. Jun. ASME, 1916; Mem. ASME, 1926. Member, also, Technical Society of New York. His wife, Rose, of New York City, survives him.

Alfred Lister (1879–1960), retired mechanical supervisor, Clark Thread Co., Newark, N. J., died, Mountainside Hospital, March 11, 1960. Born, Chicago, Ill., Aug. 16, 1879. Parents, Frederick and Fannie (Kirkpatrick) Lister. Education, graduated from Newark Evening Drawing School. Married Anna Fiedler, 1905 (dec. March 2, 1960). After serving an apprenticeship in the machine shop of the Lister Agricultural Chemical Works, Newark, N. J., 1893–1901, Mr. Lister began his long career with Clark Thread Co. as a draftsman. He was successively operating engineer and assistant mechanical superintendent. In 1913 he was appointed mechanical superintendent of the Clark Thread Co. and Clark Mill-End Spool Cotton Co. At his retirement in 1948 he was mechanical supervisor of all plants of Clark Thread Co. and its affiliates. Mem. ASME, 1913. His daughter, Emma Lister, Montclair, N. J., survives him.

Henry Fred Teichmann (1888–1960), president of Henry F. Teichmann, Inc., Pittsburgh, Pa., died March 25, 1960. Born, Hannover-Linden, Germany, Aug. 14, 1888. Son of Emil Teichmann. Education, BS(ME), Royal Polytechnic College, Hannover, Germany, 1909. Naturalized U. S. citizen, West Chester, Pa., 1915. Married Marion Nichols; children: Henry, Jr., Marion Augusta, and Newton Nichols. Mr. Teichmann was a specialist in the glass and steel industries. During employment with Lukens Steel Co., Coatesville, Pa., 1912–1918, he designed and supervised construction of one of the first 100-ton open hearths and a 204-in. plate mill. He was with Wheeling Steel Corp., Wheeling, W. Va., from 1918 to 1923. In 1923 he joined Simplex Engineering Co., Washington, Pa., as chief engineer supervising construction of plants for the glass industry. He held several patents on inventions including electric lamps and sockets, a bottle closure, a refrigerator for automobiles, and a combination keyless lock. Jun. ASME, 1916; Mem. ASME, 1926.

Adolph Emil Thomas (1908–1960), mechanical engineer, Interstate Commerce Commission, Washington, D. C., died April 2, 1960. Born, Glendale, L. I., N. Y., July 29, 1908. Education, BSE, Columbia Univ., 1939; ME, 1940. Mr. Thomas was employed by the Long Island Railroad from 1925 to 1941. During World War II he was safety and inspection officer for aircraft in the U. S. Navy and became Lieut Commander. He became an inspector for the Bureau of Locomotive Inspection, Interstate Commerce Commission in 1947. Jun. ASME, 1940; Mem. ASME, 1952.

William Quinby Wright (1877–1960?), consulting engineer, Los Gatos, Calif., died recently according to notice received by the Society. Born, San Jose, Calif., March 18, 1877. Parents, William Hanford and Myra (Quinby) Wright. Education, AB, Stanford Univ., 1900. Married Gertrude Edwards, 1900; children: W. Quinby, Phillip Edwards, and Janet Edith. Mr. Wright was a specialist in land reclamation, drainage, flood control, irrigation, and dredging excavation problems of placer mining. He began his career in 1900 as assistant superintendent and engineer with the Patterson Creek Mining Co. In 1902 he became chief engineer of the Bay & River Dredging Co. and later was president. He organized the firm of Wright-Plummer Co. to design and supervise the construction of special dredge equipment, 1906–1908. Between 1908 and 1921 he was president of Jersey Island Farm Co., president of Hastings Tract Co., director of the Tulare Lake Dredging Co., and consulting engineer for Northern California Mining Co. In 1921 he became president of his own firm, The Wright Corporation. He was also president of Monarch Dredging Co. and Tulare Lake Land Co. between 1921 and 1929. Mem. ASME, 1908. Member, also, The Society of American Military Engineers. He was a registered professional engineer in the State of California.



Yarway Remote Indicators have "wide angle" visibility from multiple vantage points

Yarway Remote Liquid Level Indicators bring distant, often hard-to-see boiler level readings right down to eye level on the panel board or other convenient location.

No matter where you stand—at any point in a 180° arc, and from a considerable distance—the brilliant new wide vision dial makes viewing and reading easy.

Accurate readings because Indicator is operated by boiler water itself

Remote readings of levels in boilers (also feed water heaters and other heat exchangers) are instant and accurate because indicator *operating mechanism* is actuated by the varying head of the liquid itself, yet the *pointer mechanism* is never under pressure.

Fully approved under Boiler Code Case #1155

Under A.S.M.E. Boiler Code Committee ruling in Case #1155, two independent remote level indicators of compensated manometric type may be used as primary indicating elements instead of one of the two gage glasses required for boiler pressures 900 psi and above. When both indicators are in operation, one gage glass may be shut off but shall be maintained in serviceable condition.

Yarway Remote Liquid Level Indicators conform to this ruling and are used widely for primary boiler water level indication in plants operating at 900 psi and above.

All Yarway Indicators for service over 700 psi are temperature-compensated; pressure compensation available when desired. Use of controlled-temperature column on constant head chamber fully protects against system upsets.

If you would like a reprint of this Boiler Code ruling, just ask for Case #1155 reprint.

Get the full story on Yarway Liquid Level Indication for your plant. Write for new 24-page Bulletin WG-1825.

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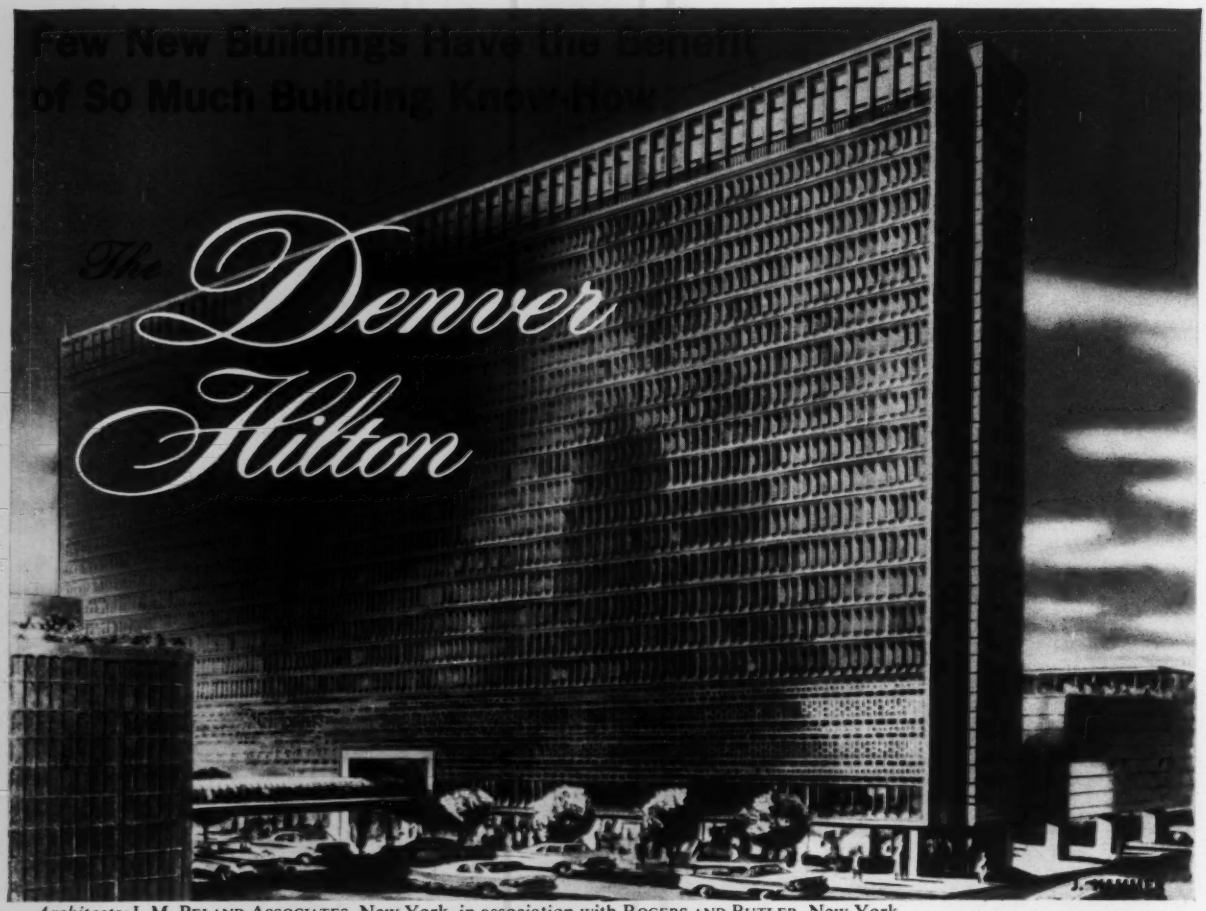


Architects: I. M. PEI AND ASSOCIATES, New York, in association with ROGERS AND BUTLER, New York
General Contractor: WEBB & KNAPP CONSTRUCTION CORP., New York • *Consulting Engineer:* JAROS, BAUM & BOLLES, New York
Air Conditioning, Heating, Plumbing Contractor: KERBY SAUNDERS, INC., New York

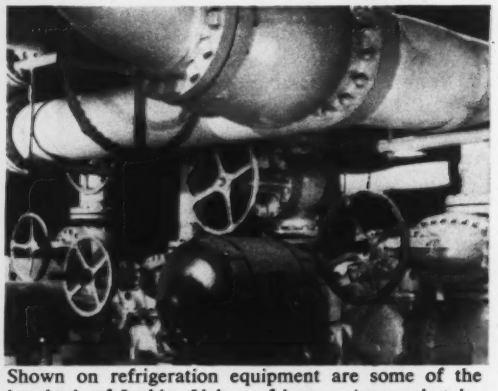
JENKINS VALVES were installed to control all service lines

The name of Webb and Knapp, Inc., owner of the new Denver Hilton, would appear in any list of people who know most about building . . . especially about building for efficient, economical operation.

Outstanding in the world of building, too, are the architects, engineers and contractors who collaborated in the design and construction of the magnificent 884-room Denver Hilton.

Few buildings have had so much knowledge and experience applied to assure trouble-free operation. And, one of the important steps taken to avoid maintenance expense and interruptions of service was the installation of *Jenkins Valves*. Heating, plumbing and air conditioning lines are controlled by valves bearing the famous Jenkins Diamond mark of reliability.

When you specify or install valves, remember that the valves preferred by so many of the country's top building experts for almost a century cost no more. In the end, they can cost less Jenkins Bros., 100 Park Avenue, New York.



Shown on refrigeration equipment are some of the hundreds of Jenkins Valves of bronze, iron and stainless steel in The Denver Hilton.

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VALVES
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Sold Through Leading Distributors Everywhere

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NEW EQUIPMENT

Semiconductor Slicing and Dicing

Brown & Sharpe's new 618 Micromaster slicing and dicing machine automatically wafers semiconductor materials such as germanium, silicon, quartz crystals, and similar materials with parallel accuracy to 0.0001 in. and consistently repeats in size to ±0.0002 in.

Utilizing a metal-bonded or resenoid-bonded diamond wheel, this easily set-up machine produces clean, "burn-free" wafers. Table driving mechanism provides smooth feed, infinitely adjustable from 0.100 to 144 ipm with rapid table positioning adjustable to approximately 25 fpm.

The table is mounted directly on the fixed bed in generous V and flat ways to eliminate table twist at transverse index. A rugged cast-iron upright moves transversely in V and flat ways on the bed casting. Cross feed is actuated automatically at the beginning of each cycle by a hydraulic-mechanical arrangement, accurate to ±0.0002 and adjustable from 0 to 0.1000 in. Total amount of index is read directly from the handwheel graduated in increments of 0.00025 in. and is adjustable independent of the handwheel to facilitate set-up.

With the addition of a wheel sleeve and by ganging wheels, wafers can be diced in quantity with one pass of the table. Where only dicing is required, machines are available without automatic crossfeed and indexing mechanism.

Unit construction of the 618 Micromaster slicing and dicing machine permits optional arrangements to be built in easily, even in the field. Available arrangements include special spindle units, spindle head-raising mechanism, special cycles, longer transverse indexing, multiple indexing, and so forth.

Unit construction simplifies maintenance and also permits conversion for conventional surface grinding. —K-1

Integral Actuators

Haydon Switch, Inc., announces new versions of its 5300 series subminiature switches available with integral leaf and roller leaf actuators.

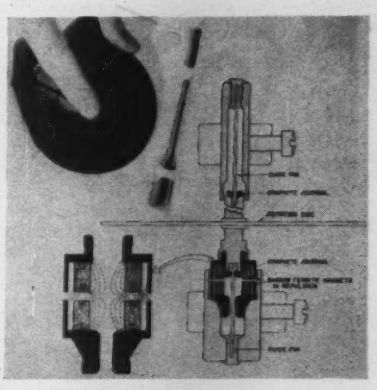
The basic switch meets the requirements of MIL-S-6743 and vibration per Procedure II of MIL-E-5272A. It is combined with an integral actuator which is rigidly secured by a rivet to the top of the Diallyl Phthalate plastic case. —K-2

Primary Torque Standard

In order to calibrate torque indicators, Autotronics, Inc. has developed the primary torque standard which consists of a simple balance arm, accurately measured and notched, and a set of standard weights of known accuracy. A pointer and reticule insure accurate resolution of the center or null position.

To calibrate, the indicator is attached to the balance arm by means of the integral shaft of the torque standard. A weight is selected that will give the proper torque desired and is placed on the balance arm at the appropriate mark. The balance arm is marked off in 1-in. increments. Thus a 1-oz weight placed at the 10-in. mark equals 10 oz-in. Since the balance arm extends both to the left and right, counterclockwise and clockwise calibrations can be accomplished with the same setup. Since 1, 5, 10, and 20-oz certified weights are supplied with the larger torque standard, calibrations are possible from 1 to 200 oz-in. using single weights and even higher ranges using combinations of weights.

The method of calibrating the torque indicator is to balance the static weight by rotating the torque indicator to achieve a null indication on the pointer. Reading the dial will then give the indicator reading directly in ounce-inches on gram-centimeters and this reading is plotted on a calibration chart. —K-3



Watt-Hour Meters

Magnetic bearing systems of an entirely new type have replaced conventional ball-and-jewel bearings in a line of single-phase 120/240-volt watt-hour meters announced by the Westinghouse meter department.

Disk-and-shaft assemblies are supported in space by the magnetic repulsion between two tiny rings of barium ferrite, a ceramic permanent-magnet material of exceptional stability and strength. Mounted so that their fields are opposed, these rings serve as the two "working surfaces" of a frictionless thrust bearing. Supplying the slight lateral forces needed to restrict horizontal movement are stationary pins within graphite journals, which serve as guide bearings for the upper and lower ends of the shaft.

The new Magnethrust bearing design will be used in all single-phase meters produced by Westinghouse after June 1, 1960. The new D2S meters will be priced competitively with existing designs and have improvements in the light-load adjustment, dual-voltage performance, stability, and corrosion resistance.

They will be able to withstand shock and vibration well above levels encountered during transit, have immunity to thermal shock and environmental change, tolerance to off-vertical installation, and be able to serve for "at least 30 years" without maintenance.

Life tests conducted at maximum torque under a variety of test cycles have produced no discernible wear after 100,000,000 shaft revolutions.

Since it is used for all equipment in the line of D2S watt-hour meters, the new Magnethrust bearing will be available in meters with voltage ratings of 120, 240, 480, or 600 volts and current ratings of 2.5, 15, or 30 test amp. All meters in the line are designed to accommodate loads up to 667 per cent of meter rating. —K-4

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BIN VIBRATORS

Vibra-Flow
VIBRATORY FEEDERS

keep bulk materials flowing freely, increase production, reduce material handling cost

A SYNTRON Bin Vibrator on a bin or hopper keeping materials flowing freely to a SYNTRON Vibratory Feeder feeding materials at a smooth, even controlled rate to conveyor belts, crushers, screens and other process equipment is an efficient, dependable combination to increase production, eliminate bottle necks and reduce.

SYNTRON Vibrators and Feeders offer simplicity of design, compactness and rugged construction. The electromagnetic drive eliminates mechanical wearing parts, assures dependability of operation, increases service life and lowers maintenance costs.

Because of the instant control of amplitude or power of vibration, which may be manual or automatic, SYNTRON Vibrators and Feeders are easily integrated into continuous operations. SYNTRON can help you with many of your materials handling problems.

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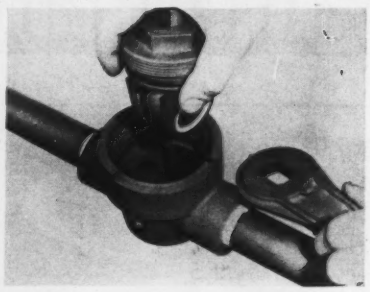

Thermoplastic Piping

Top-entry, top-adjusting thermoplastic ball valves have been announced by Tube Turns Plastics, Inc.

The new valves, formed by TTP's exclusive process of injection molding, are made of unplasticized polyvinyl chloride for operating temperatures to 150 F and Penton (new chlorinated polyether) for hot corrosive service to 250 F and higher. They come in $^1/_2$ through 3-in. nominal pipe sizes, threaded or socket type.

The unique top-entry feature of the ball valve makes it possible to perform on-the-line maintenance almost instantaneously. Quick, easy access to working parts without disconnecting any piping is achieved by simply unscrewing the valve bonnet and lifting out the molded, one piece ball-and-stem and self-lubricating Teflon seating inserts. An adjusting nut on the valve bonnet also enables adjustment of ball-seating force from the top, eliminating the need to break or adjust connected piping in order to perform this operation.

—K–5

Glass Pillows and Balls

Tiny pillows up to $^1/_2$-in. length and balls of glass up to $^1/_2$-in. diam are being produced by Corning Glass Works as a low-cost material for filler, packing, filtering, and tumbling applications in varied industrial processing and commercial uses.

Chemical stability, heat resistance, easy and inexpensive forming and uniformity of shape and size characterize the glass pillows and balls.

The hollow pillows provide a low density filler material for such applications as packing in aircraft wings where the glass gives both structural support and buoyancy. They also can be used as a filler material in the casting of larger plastic pieces.

The solid pillows are being used in chemical processing as fillers in refractionating columns and in filter beds. Their tumbling action provides the necessary agitation in electroplating operations.

In commercial application, the ball-shaped pieces are used in the antilint filter of an automatic washing machine. The balls pick up the lint which is then back-flushed. This prevents clogging and stoppages.—K–6

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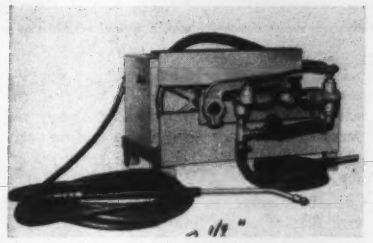


Cleaner

Multi-Job Washer, an all-electric cleaner for machinery, equipment, and parts, is announced by Homestead Valve Mfg. Co. It is both powered and heated by electricity. Its positive-displacement pump draws cleaning solution from a drum or tank. The solution is heated electrically, and delivered at up to 180 F. Pressure of the hot cleaning solution may be increased from 250 to 300 lb, simply by changing the gun-nozzle orifice and a single control. The manufacturer emphasizes that the Multi-Job Washer is not a steam cleaner, but a many-purpose machine that combines heat, high pressure, and a new detergent—Multi-Job Cleaning Compound—to do a good job of cleaning machinery or equipment, washing cars, motors, or doing many other jobs. It fits the top of a 55-gal drum and operates on 220-volt, 60-cps, single-phase, a-c current, is equipped with 40 ft of solution hose, gun, and two nozzles; and weighs approximately 106 lbs. **—K–7**

Bellows

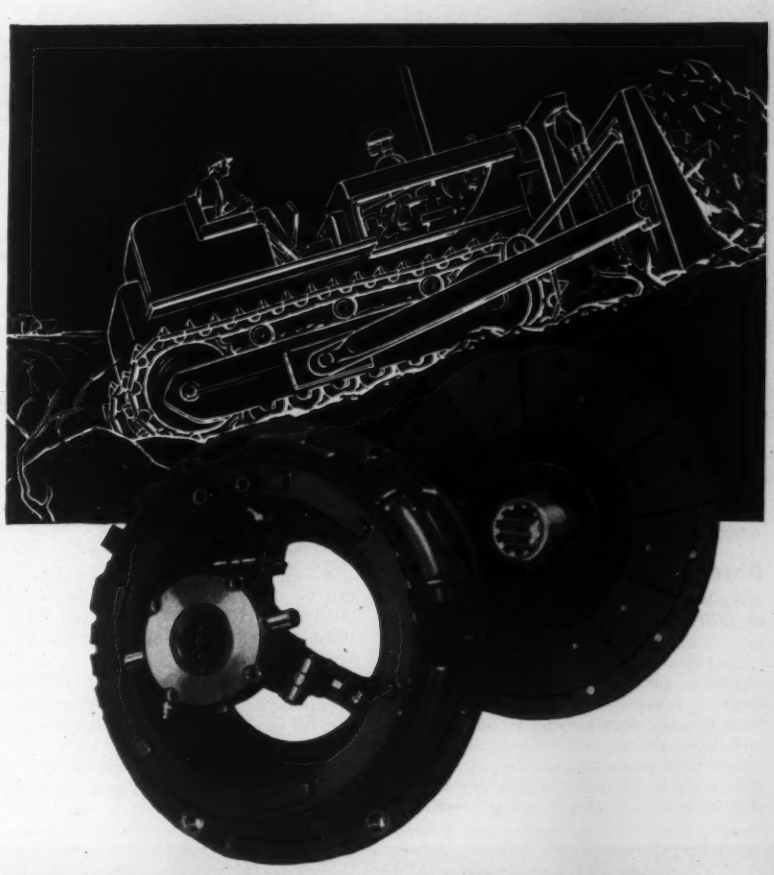
A bellows for high-temperature gas lines, particularly those required in airborne Auxiliary Power Unit systems is being produced by Hydrodyne Corp.

These high-temperature gas-bellows assemblies are used in pairs. They allow 0.11 in. for 5 in. of angular-offset movement to relieve the problem of expansion and contraction in the lines due to change in gas temperature.

The bellows sections are machined bellows, designed for operating pressure of 1400 psig with gas temperatures to 1200 F. Material selection is determined by the customer's specific application. **—K–8**

Flow Tube

A new design of the Builders-Providence Dall Flow Tube is for special requirements in the metering of petroleum, chemicals, gases, steam, and other process fluids at low or high pressures and temperatures. Made by B-I-F Industries, it offers the process engineer design flexibility—sizes from 1 to over 120 in. in a variety of metals, maximum head recovery, short laying length, stable coefficient, and predictable accuracy. **—K–9**



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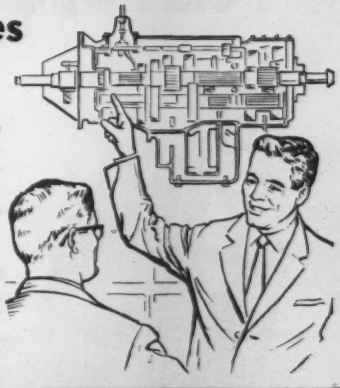
BETTER PRODUCTS!

Cooperation produces the final design



When each component part is the best, the whole machine is right. Rockford Over-Center Clutches are the finest made for crawlers, cranes and other heavy-duty equipment. If your equipment is in the design stage, let Rockford Clutch engineers help you select the best clutch. Rockford Clutches in standard sizes suit almost every need. Custom models can be designed for your applications. Call or write for the Rockford Clutch Catalog.

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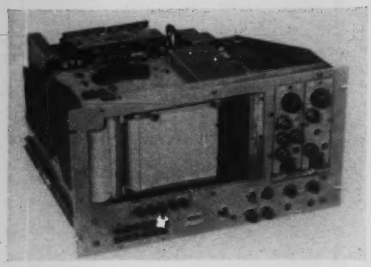

Direct-Writing Oscillograph

A self-contained two-channel direct-writing oscillographic recorder that can be either rack mounted in 10½ in. of panel space or housed in a portable case has recently been introduced by Sanborn Co. The instrument is extremely versatile because of its mounting flexibility and also because it uses plug-in interchangeable 850-style preamplifiers which are available in many different types. Model 297 is designed for applications in large instrumentation set-ups for monitoring. **—K-10**

High-Lift Pump

A pump that uses a unique, positive-displacement pumping action to literally squeeze water upward has been developed by Peerless Pump, Hydrodynamics Div., Food Machinery and Chemical Corp.

Trade named the Hi-Lift, this pump employs a corkscrew-like rotor which rotates within a contoured stator. The action of the rotor creates a positive displacement action, moving a constant flow of water up to the surface.

According to the manufacturer, the pump can be operated at one-half the normal pump speed (1760 rpm), thus assuring longer pump life and greater operating and maintenance economy.

In addition to the advantage of low-rpm operation, which saves power and adds pump-life, the pump develops high pressures without change or adjustment. This feature is especially desirable when pumping into pressure tanks, elevated tanks, or when fighting fires.

It is also extremely adaptable to varying pumping conditions. For example, if the water level in the well should drop, the pump can be lowered simply by adding extra sections of column.

Four series are currently available. Capacities range from 500 to 3300 gal per hr with lifts of up to 1000 ft and pressures to 50 psi. The pumps will fit in wells with 4-in. ID and larger. All types of drives may be used with this pump. **—K-11**

Impedance Comparator

A new version of the Impedance Comparator, Type 1605-AS2, is a double-duty instrument that provides laboratory accuracy in production-line testing, as well as for laboratory measurements.

The device made by General Radio Co. serves to compare a resistor, capacitor, or inductor with a standard sample, indicating directly on panel meters the magnitude and deviation of impedance difference and phase-angle difference between them. **—K-12**

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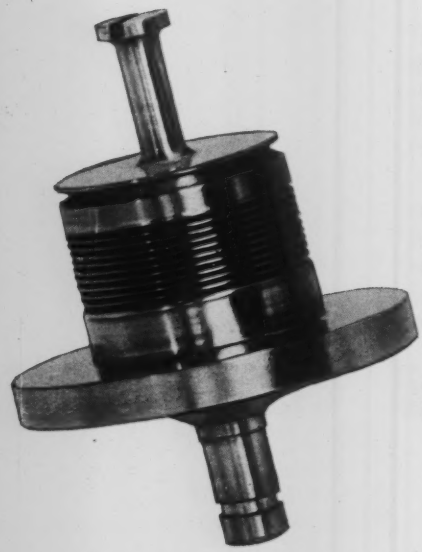
ONLY *Robertshaw* gives you this



Only a welded bellows like FORMWELD can give you the accuracy and stronger physical properties you need for many modern applications. Proper selection and welding of any suitable alloy now give you a premium bellows for heats above 1000°F . . . for pressures in the 3000 psia range . . . for service in severe corrosive atmospheres or under high shock and vibration conditions.

Zirconium, Inconel-X, Titanium, Hastelloys, Monels, Ni-Span-C and several stainless steel grades are among the alloys available. Other outstanding advantages include closer control of effective area, lower spring rates, greater resistance to deformation under high loads and much lower hysteresis. Robertshaw saves you money by producing the complete "package" . . . in bellows sizes from ½" O.D. to many times that size.

Remember, only Robertshaw can recommend and custom-engineer *either* type of metallic bellows that will do your job best.

WRITE FOR FORMWELD BELLOWS BULLETIN D-707

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NEW EQUIPMENT BUSINESS NOTES LATEST CATALOGS

Force Gages

A series of precision mechanical force gages for measuring tension in a permanent test set-up is announced by Hunter Spring Co. Div., American Machine & Metals, Inc. The force indicator's free-floating transmission rod, which transmits the tension load to a dial indicator, is threaded ($^5/_{16}$–18) at its end for mounting in test apparatus or fixtures.

The compression head for measuring compression forces, removable end attachments for measuring tension, and the means for hand holding with detachable handles which are part of Hunter's standard DM series designed for manual measuring have been eliminated to reduce cost.

Like the DM series, the new Series DT force gages are available in capacities of 20, 50, 75, 100, 150, 200, and 500 lb. Both series are capable of measuring all forces up to their maximum capacities with accuracies of ±0.1 lb for D20T, ±$^1/_4$ lb for the 60-lb model, ±$^1/_2$ lb for the 75 and 100-lb models, ±1 lb for the 150 and 200-lb models, and ±2$^1/_2$ lb for the 500-lb model.

Like other models the DT series is able to hold the maximum dial reading after the load has been removed. This makes it useful for measuring momentary or transient loads. A control button on the instrument is used as a selection device for setting the type of operation desired—either to follow all load fluctuations or to hold the maximum reading. When the dial-indicator hand is set to hold the maximum reading a slight touch of the release-and-reset tab, located over the control button, returns the pointer instantly to zero, ready for the next measurement.

The DT series is ruggedly constructed and housed in a cold-rolled steel case with a black wrinkle finish. Internal construction features a fully compensated spring mechanism and a precise dial indicator.

—K-13

Motor-Generator

A series of combination electric motor and 60-cps a-c generators has been developed by Kato Engineering Co. The motor-generator sets are designed to be used in pairs and to provide a continuous source of 60-cps a-c current. Out is 10 kva and speed is 1760 rpm. In case of power line failure, the generator is driven by a gasoline or diesel engine which is automatically brought up to proper speed so that the frequency dip will not exceed approximately five or six cycles. To minimize dip in frequency and voltage when normal power fails, the motor generator is carried by the momentum of a massive fly wheel and either a gasoline or diesel engine may be used as prime mover.

The generators are powered with either single-phase or 3-phase induction low-slip motors. Regulation is by a magnetic amplifier mounted on the collector ring or the generator end. Voltage regulation is approximately 1 per cent; harmonics 3 per cent; response time 0.4 sec; length 3 ft 11 in.; width 17 in.; height 18 in.; weight 698 lb net.**—K-14**

FORMFLEX* (Hydraulically Formed)

choice in metallic bellows!

Only a Robertshaw FORMFLEX seamless metallic bellows or "packaged" metallic bellows, made in the industry's most up-to-date production facility, can give you the quality you want and the performance required!

Robertshaw is now able, through its Bridgeport Thermostat Division, to meet your requirements for bellows as small as $^1/_8$" O.D. In addition, Robertshaw can custom-engineer and produce bellows in any quantity . . . with consistent quality from unit to unit and shipment to shipment. Widest choice of bellows metals to provide the desired strength and performance characteristics. Finest testing equipment and procedures known.

Miniature sizes of $^1/_8$", $^1/_4$" and $^5/_{16}$" O.D., plus larger sizes to several inches O.D. Cost savings are possible when Robertshaw produces the complete "package". Remember, only Robertshaw can recommend either type of bellows without bias.

*Registration pending

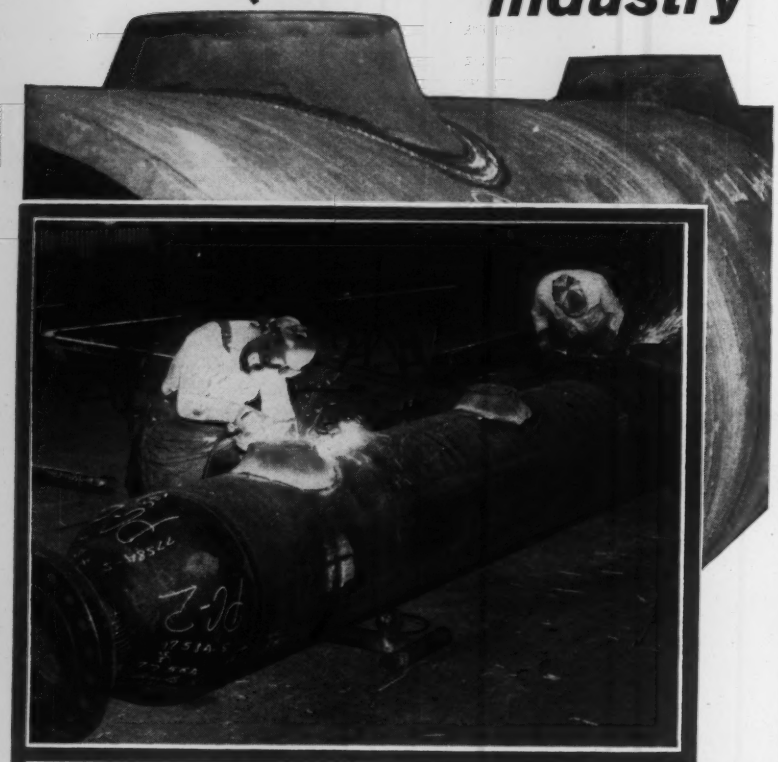
WRITE FOR FORMFLEX BELLOWS BULLETIN D-107

Robertshaw MR. CONTROLS

BRIDGEPORT
THERMOSTAT DIVISION
Robertshaw-Fulton Controls Company
Milford, Connecticut

BONNEY SWEEPOLETS Pat. Pend. ®

---are SWEEPING the pipeline industry



The Bonney Sweepolet is an integrally reinforced insert butt welding pipe fitting specially designed for stress free branch connections on high pressure pipelines.

WRITE FOR CATALOG S-1A

BONNEY FORGE and Tool Works

ALLENTOWN, PENNSYLVANIA

BONNEY

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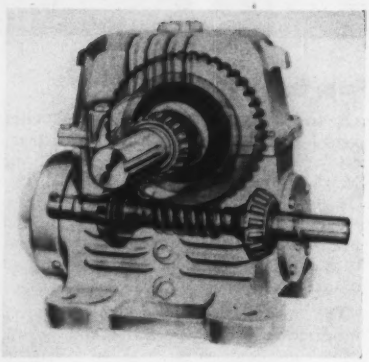

Speed Reducers

Link-Belt Co. has introduced a completely new line of fan-cooled worm-gear speed reducers available in 25 types and over 135 different sizes. Ratios range from 5:1 to 3600:1, with torque ratings up to 135,000 lb-in. and horsepower ratings up to 150.

Link-Belt worm-gear speed reducers are right-angle drives which adapt compact, high-speed motors to modern production machines. They can operate at high input speeds and cover the range from fractional to large horsepower motors as demanded by industry. They offer low output speeds with ample capacity for heavy loads, assuring smooth, quiet transmission of power with minimum maintenance.

Easily recognized by their external ribs, these new speed reducers have housings that combine strength, rigidity, and ample cooling area. The fan cooling and other design refinements allow the size of these units to be reduced while retaining their high load-carrying capacity.

Automatic lubrication is provided by a splash system between the oil reservoir and internally cast channels to the bearings except on the low-speed shaft, where grease fittings are provided. Oil seals are furnished on all shaft openings. **—K-15**

Wide-Angle Spray Nozzle

Spraying Systems Co. has announced a spray nozzle, providing a new full-square spray pattern and extremely wide-angle projection. It is designed for installation on spray manifolds where open area is dimensionally limited.

The average spray angle of 110 deg provides wide coverage within a short distance between spray nozzle and work. The square spray pattern on manifold, multiple-nozzle installations, permits spray overlap to be kept to a minimum while still providing total coverage. Wide angle square-spray full jet nozzles are supplied in capacities ranging from 5.9 to 48 gpm at 30 psi, in choice of male and female pipe connections. **—K-16**

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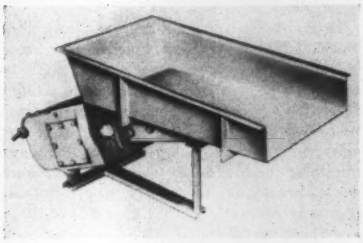


Light-Duty Feeder

Syntron Co. announces the development of a new light-duty vibratory feeder, Model F-212, capable of feeding nearly all dry, bulk materials from light, fine powders to heavy, coarse granular bits and chunks at up to 50 fpm.

The electromagnetic drive unit, which includes the spring system, is completely enclosed. It is dust-proof, moisture-proof, and splash-proof.

This highspeed vibratory feeder can be fitted with various sizes of flat pan or tubular troughs—either of carbon or stainless steel. It is furnished complete with control box, for operation from 115, 230, or 460-volt, 60-cps a-c. **—K–17**

Lightweight 900-F Joint

A lightweight version of its high-strength 900-F threaded fastener has been developed by Standard Pressed Steel Co. for aircraft, missile, and other elevated-temperature use.

Actually two new products in one—an LWB 922 bolt and companion FN 922 nut—the new high-temperature joint is 20 to 30 per cent lighter than the pioneering TM 9 bolt-and-locknut combination introduced two years ago for applications up to 900 F.

Similarly rated at 220,000 psi minimum tensile at room temperature and tested out at 170,000 psi tensile at 900 F, the new 922 series sheds weight via reductions in dimensions of the 12-point external wrenching nut and bolt head. The mechanical strength and fatigue properties of these lightweight assemblies are equal to those of the heavier counterparts.

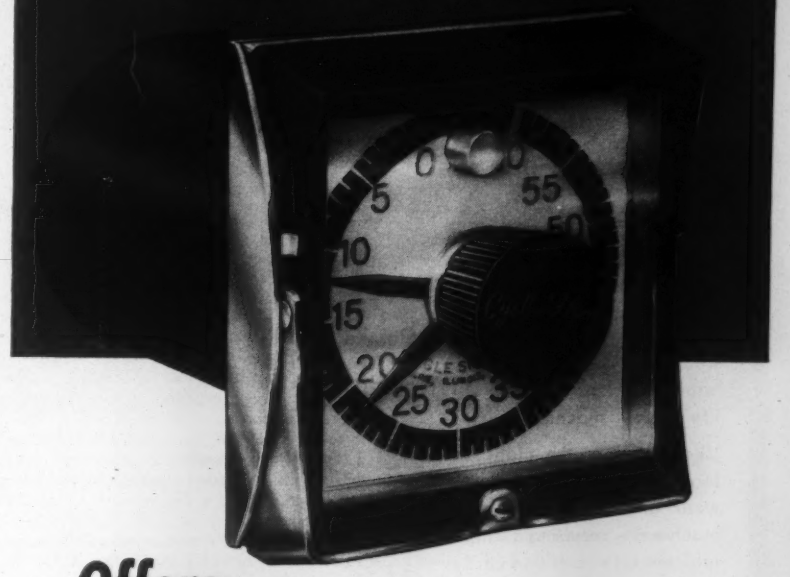
The LWB 922-FN 922 combination is intended for use with harder aircraft and missile structural materials, such as the higher strength aluminum alloys, stainless steels, and the superalloys. The TM 9 bolt and nut are still recommended for usage with softer materials.

The LWB 922 series has exceptional fatigue and stress-rupture properties. Room-temperature endurance limit is 90,000 psi at 8,000,000 load cycles in tension-tension fatigue testing. The joint has a 100-hr stress-rupture strength of 130,000 psi at 900 F. **—K–18**

new *plug-in timer*

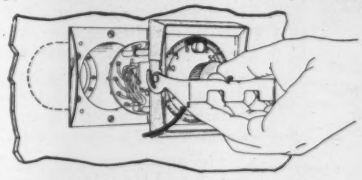
for controlling industrial processes

EAGLE'S HP5 CYCL-FLEX

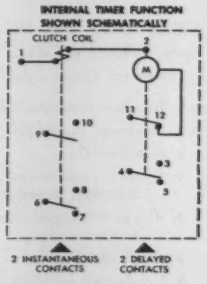


Offers:

- *Fast, easy installation*
- *Quick change of time ranges*
- *Quick means of localizing trouble*



To Remove: Lift handle and pull out



With 4 switches — 2 switches operate instantly when timer is energized — 2 switches operate with time delay — delay time adjustable — selection of dials from 10 seconds to 60 hours. Write Dept. ME-760.

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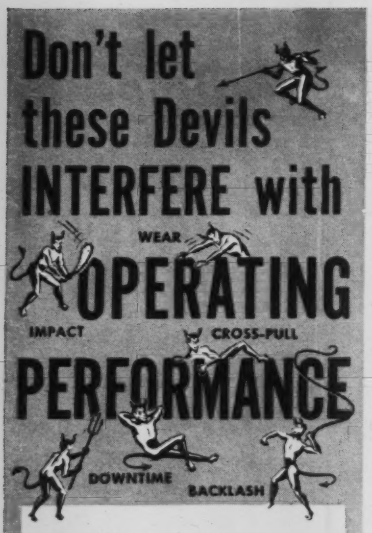
PRODUCTION ENGINEERING SHOW SEPT. 6-16 1960 NAVY PIER, CHICAGO BOOTH NO. 381

EAGLE SIGNAL COMPANY

Moline, Illinois

The Most Complete Line of Time-Count Controls



Troublesome maintenance and lubricating problems are eliminated when you specify Thomas "All-Metal" Flexible Couplings to protect your equipment and extend the life of your machines.

Like a thief in the night an inadequate coupling causes wear and damage to your machines — resulting in high maintenance costs and costly shut-downs.

NO MAINTENANCE
NO LUBRICATION
NO WEARING PARTS
NO BACKLASH

UNDER LOAD and MISALIGNMENT only THOMAS FLEXIBLE COUPLINGS offer all these advantages:

- Freedom from Backlash
- Torsional Rigidity
- Free End Float
- Smooth Continuous Drive with Constant Rotational Velocity
- Visual Inspection While in Operation
- Original Balance for Life
- Unaffected by High or Low Temperatures
- No Lubrication
- No Wearing Parts
- No Maintenance

Write for our New Engineering Catalog 60

THOMAS FLEXIBLE COUPLING CO.
WARREN, PENNSYLVANIA, U.S.A.

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NEW EQUIPMENT
BUSINESS NOTES
LATEST CATALOGS

Directional-Control Valve

A large capacity three-way directional control valve has been added to the A series line of solenoid valves manufactured by Skinner Electric Valve Div.

Available in $^{3}/_{32}$, $^{1}/_{8}$, and $^{5}/_{32}$-in. orifice sizes, the new valve is designed for directional control of such media as air, oil, and inert gases. It can be used on vacuum down to 5 microns. Compact, light in weight, the valve mounts in any position directly to the line and operates on pressure differentials up to 250 psi, depending on orifice size desired. **—K-19**

Miniature Self-Locking Nuts

A complementary pair of miniature floating-anchor nuts has been developed by the Elastic Stop Nut Corp. of America especially for the assembly of miniaturized electronic modules in advanced military communication systems. Designed for dependable self-locking performance at operating temperatures up to 550 F, nut types LHA4259 and LHA27M give engineers maximum reliability and installation-method simplicity at a minimum size and weight penalty. Parts are engineered to conform to the requirements of MIL-E-19600 for vibration, shock, and crash safety and to MIL-N-25027 (ASG) for locking torque.

Type LHA4259 straddle-mount anchor nut offers a simplified nondeforming vibration-resistant method of fastening $^{1}/_{16}$ printed-circuit boards to interior walls and brackets of electronic units. Parallel lugs centered on the nut basket straddle the edge of the board and are fastened by two $^{1}/_{16}$ rivets. Center mounting of the nut eliminates eccentric loading of the circuit board as the screws are tightened. Individual circuit-panel removal from the outside without removing other panels plus elimination of costly special fittings to hold and separate the circuits within the box permits greater freedom of design.

The miniature right-angle floating anchor nut, type LHA27M is suggested for attachment of cover plates on electronic modules. Built-in float of the nut body permits it to be self-locating and allows for possible misalignment between screw and nut. The self-locking fastener is mounted by two $^{1}/_{16}$ rivets.

Made of cadmium-plated, heat-treated carbon steel, both of these fasteners are designed to operate at temperatures up to 550 F and can be furnished with a molybdenum-disulfide dry-film-lubricant finish. Type LHA27M is also made of A286 nonmagnetic, heat and corrosion-resistant alloy for temperatures up to 900 F. Silver plate or molybedenum-disulfide dry-film-lubricant finish is available depending upon requirements. LHA4259 straddle-nut parts are available in the 4-40 thread size and the LHA-27M right-angle-bracket nuts are available in the 4-40 and 6-32 thread sizes. **—K-20**

Bearing Liner

Bronze-bushed journal bearings and pillow blocks with a precision bronze liner, that is replaceable without removing shaft or bearing base, are being produced by Dodge Mfg. Corp. Stock liners, machined from cast cylinders of high-grade leaded-bronze alloy, or special alloys for higher temperature minimize the loss of downtime and the hard work of replacing liners. The shaft pressure is simply relieved, the old liner popped out, and the new one rolled in.

Other features of these bronze-bushed bearings are rugged semisteel housings to withstand heavy shock loads (ductile iron or steel are available on order). Bottom of the base is machined for perfect alignment and close tolerance held to center of bore. A brass spool locks both halves of the bronze liner to prevent lateral movement and rotation without pins or screws. A tongue-and-groove joint in four-bolt base sizes prevents the bearing cap from shifting. Bearing ends are machined to take thrust. A grease groove provides for proper distribution of lubricant. **—K-21**

Oil Seal

A shaft-type oil seal that avoids major causes of oil-seal leakage is available from Chicago Rawhide Mfg. Co.

The new unit, called the C/R Scotseal (Self-Contained Omnipurpose Type Seal), is claimed to be an entirely new concept in oil-seal design. The oil-sealing lip is secured and completely enclosed so that it seals within the unit and does not contact the shaft. The sealing surface, normally a responsibility of the user, is provided by the seal. In effect, the seal is a self-contained oil-sealing, dirt-excluding cartridge.

By using this unique self-contained design, it precludes damage and leakage through improper handling before assembly, damage by assembler or shaft during installation, or by improper shaft finish. These are considered the major causes of leakage.

The seal consists of two parts that have relative motion to each other. The outer unit is an encasing shell. A portion of the inner surface of this shell serves as the surface against which the sealing member runs. The inner unit is the metal-reinforced synthetic-rubber sealing member. In most designs, the sealing member push-fits over the shaft and becomes a part of it—moving with the shaft. The metal case or shell press-fits into the housing bore.

Because the sealing element is enclosed, prelubricant applied during fabrication stays in place and lubricates the sealing lip through centrifugal action. This gives extra protection to the seal, particularly during starved conditions. **—K-22**

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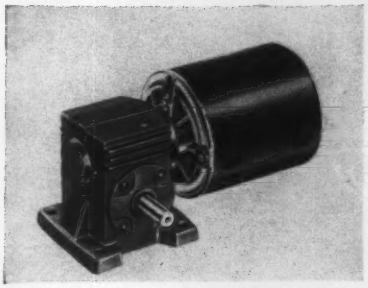


Speed Reducer

Compact assembly for space-saving design characterize the M109 Ratiometer introduced by Boston Gear Works.

A horizontal right-angle drive M109 is powered by specially designed 1/20 or 0.035-hp motors, and provides a full range of output speeds from 43.8 to 350 rpm.

A simple, standard mounting bracket permits easy mounting in many positions without mechanical alteration. **—K–23**

Ball-Bearing Pulleys

A series of low-cost ball-bearing pulleys, for use with rope, wire rope, or cable is available from Syracuse Bearing Co. Six standard sizes of pulleys handle cable sizes up to 1/4 in. diam; OD's range from 7/8 to 2 in. and bores from 3/16 to 3/8 in.

The bearing rings of these units are made of case-hardened steel to provide high load capacity and cable-groove wear resistance. Precision steel balls, operating in unground raceways, provide free turning at low cost. The units are cadmium plated for corrosion resistance.

Grooves are tapered and rounded to accommodate considerable latitude in cable or rope diameter. The hardened tapered grooves and low bearing friction ensure minimum cable slippage and groove wear. **—K–24**

Hydraulic Packing Material

Several desirable performance characteristics are availabe in an economical new hydraulic packing material by E. F. Houghton & Co.

According to the company, a plastic and an elastomer have been compounded to produce a new packing material called Rex-Syn, which is highly resistant to abrasion and which can be used in both acid and alkaline applications from 0 to 212 F.

Laboratory evaluations have set tensile strength of the low-friction packing at over 3000 psi, and elastic limit is almost 300 per cent. The material seals effectively in air, oil, water, and water-based fire-resistant hydraulic media. **—K–25**

If you're a bellows user, odds are high against one of these being yours: they're merely typical of the thousands of different types we've produced for almost every branch of industry.

Name your conditions of stress, atmosphere, temperature, vibration, pressure . . . tell us the flexibility, sensitivity, durability you need.

Backed by the most experienced know-how in the field, every Robertshaw Bellows is custom-engineered to do a particular job . . . and do it more efficiently, more economically.

Get the full story on Robertshaw Bellows and Bellows Assemblies . . . and some good, solid bellows background . . . in Catalog NK-R. FULTON SYLPHON DIVISION, ROBERTSHAW-FULTON CONTROLS CO., KNOXVILLE 1, TENNESSEE.

A. Brass aneroid assembly, ambient pressure compensation. Large bellows for added power and sensitivity.

B. Beryllium copper aneroid assembly for aircraft pressure controls. Highly flexible, durable, sensitive. Silver-brazed construction.

C. Pressure sensitive brass bellows with special end fittings.

D. Brass thin-walled bellows for extreme sensitivity and flexibility.

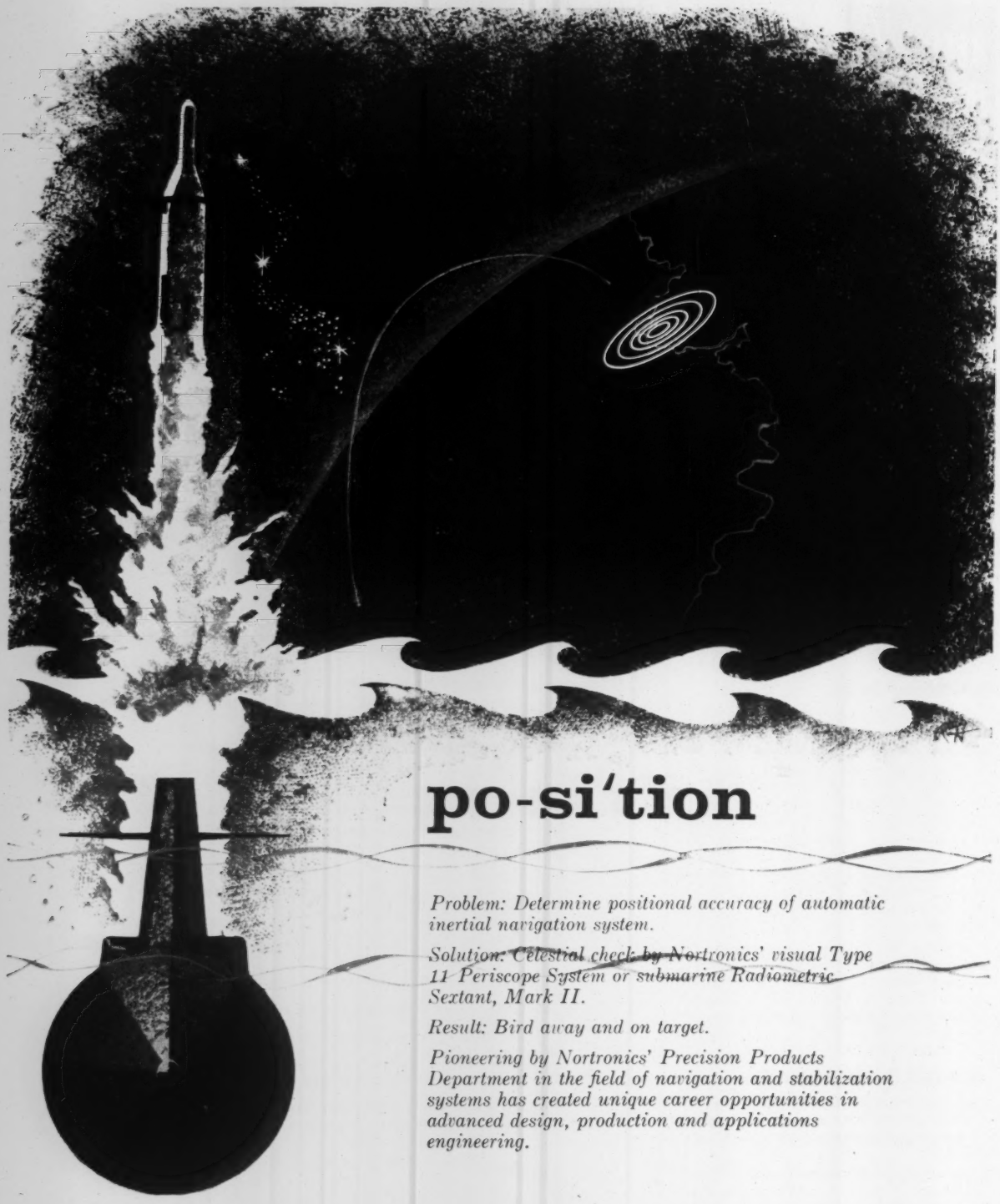
E. Liquid filled thermostatic assembly; pressure insensitive.

F. Seamless, stainless steel bellows; welding ends. For vibration isolation or misalignment; accommodates pipe movement on sealed systems.

G. Highly flexible brass bellows for aircraft; compensated for ambient pressure changes for absolute pressure response.

Robertshaw

MR. CONTROLS



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Problem: Determine positional accuracy of automatic inertial navigation system.

Solution: Celestial check by Nortronics' visual Type 11 Periscope System or submarine Radiometric Sextant, Mark II.

Result: Bird away and on target.

Pioneering by Nortronics' Precision Products Department in the field of navigation and stabilization systems has created unique career opportunities in advanced design, production and applications engineering.

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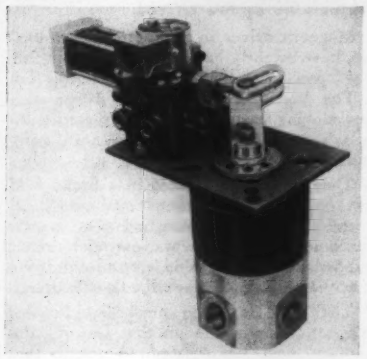

Shear-Seal Valves

Cylinder-operated shear-seal valves, rated for 10,000, 6000, and 3000 psi hydraulic, oil, or water; and 10,000, 4000, and 2000 psi air are covered in Barksdale Valves Catalog COV 60-61.

They are available in 4-way, 3-way, and shut-off flow patterns. Port sizes range from $^1/_4$ through $1^1/_2$ in. NPT. The operators are obtainable with cushioned or non-cushioned cylinders for 80 to 250-psi air pressure and for 500-psi maximum oil or water pressure. **—K–26**

Seamless Welding Fittings

Midwest Piping Co. has added seamless carbon-steel welding fittings to the present extensive line of welded-type fittings. The seamless fittings are available in all types, in sizes ranging through 24 in. Each fitting is hot coined—sized in compression for its entire length, producing true over-all roundness which permits segmenting at any point.

Ends of the seamless fittings are machined inside and out to insure circle-perfect roundness. Both ends are machined simultaneously with the fitting in a fixed position to assure fittings that are plumb and square. Wall thickness and uniformity are greater than required by ASA standards. **—K–27**

Mist Coolant Unit

A self-contained mist coolant unit with a 5-gal reservoir capacity, engineered and styled to become an integral part of the machine it services, has been announced by Bijur Lubricating Corp. Units are also available with 1-gal or 18-oz capacity reservoirs.

To eliminate the usual tangles of tubes, valves, and awkward supply tanks, Spraymist is so designed as to include in one compact unit air filter, trap, regulator and gage, solenoid valve and conduit box, pressurized coolant reservoir and filter. Pressurized-coolant reservoir permits mounting in any location without siphon-lift problems, no interrupted flow, no air waste. **—K–28**

Thin-Shell Needle Bearings

A greatly expanded line of Kaydon thin-shell needle bearings in 15 sizes from $^3/_8$ to $1^3/_8$ in. in bore is available from Kaydon Engineering Corp.

Key feature of these thin-shell needle bearings is the use of spherical-end needle rollers, billions of which have been used for automotive transmissions and universal joints.

Spherical-end needle rollers permit up to 90 per cent more capacity and up to 6.85 times more bearing life than comparable bearings with conical-end rollers. This greatly increased capacity allows the use of smaller bearings for a given load requirement.

Simplified construction, lower initial cost, and prepacked lubrication save assembly-line handling and installation time.

Bearings now available range from $^9/_{16}$ to $1^{11}/_{16}$ in. OD and from $^1/_4$ to $1^1/_8$ in. in width. All sizes exceed requirements for operation at speeds up to 6000 rpm. Additional sizes are being added to meet other specifications.

Rollers are made of high-carbon chrome-alloy steel with a minimum hardness of R_c 60. Shells are made of electric-furnace, aluminum-killed bearing steel with a minimum R-15N 90 (R_c 60) hardness.

Introduced by Kaydon in 1956, thin-shell needle bearings are used in agricultural and construction equipment, aircraft, power tools, lawn mowers, two-cycle engines, chain saws, and automotive transmissions and steering mechanisms. **—K–29**

Set Screws

A wide variety of No-Mar Set Screws with Nylon tips is offered by P I C Design Corp., a subsidiary of Benrus Watch Co.

When the set screws are applied in a gear or hub and tightened to a basic shaft, the nylon tip protects the shaft from marks or mars and has full face contact rather than 2 point contact, as in conventional cup-point set screws.

When locked in place, the nylon material deforms to the shape of the curved shaft, and imbeds itself in the thread hole, thus, offering a self-locked washer effect. They are available with slotted head or socket head in sizes from No. 2-56 to $^1/_4$-20, and in a variety of stock lengths. **—K–30**

Use a CLASSIFIED ADVERTISEMENT
for Quick Results

po-si'tion

A NOTE FOR TALENTED ENGINEERS:
We invite your inquiry as to important positions that exist at Nortronics' Precision Products Department (formerly the Military Products Division of American-Standard).

Plan your future with Nortronics' Norwood team and stimulate your professional growth. If you can qualify in one of several electro-mechanical areas you will work on challenging programs with professionally dedicated associates.

FOOTNOTE: *Excellent salaries for qualified engineers in both our Systems and Components Groups.*

Contact E. P. REARDON, *NORTRONICS Precision Products Department, Norwood, Massachusetts*

NORTRONICS
A Division of
NORTHROP CORPORATION

Is clean, dry, oil free air

designed into your

Compressed air system?

Only with Adams Aftercoolers and Cyclone Separators can you get virtually **complete** removal of pipeline oil and water vapor — for these reasons:

1. MORE COMPLETE CONDENSATION. Adams Aftercoolers reduce air or gas temperature to within 10° of cooling water. With their efficient counter-flow design, the air passing through the tubes is cooled by 13-pass cooling water over the tube bundle. This cooling achieves maximum condensation of oil and water vapor.

2. MORE COMPLETE SEPARATION OF OIL LADEN CONDENSATE. Adams Cyclone Separators have a unique conical design which produces efficient, 2-stage separation; first, heavier particles in the upper portion; then the finest particles are removed in the inner vortex formed within the conical area. This offers a constant high separation factor over a wide range of volumes—a characteristic not possible with baffle and other type separators.

You pay no more for superior Adams performance because of Adams specialization in these units for over 25 years. They have engineered the extra features into mass-production techniques which keep unit costs down.

New Bulletin 714 merits your attention for fullest possible protection to your air-actuated equipment. Write for your copy today.

R. P. ADAMS CO., INC. • 204 East Park Drive, Buffalo 17, N. Y.

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BUSINESS NOTES
NEW EQUIPMENT
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Fabric Dust Collector

A high efficiency, low-cost, cylindrical fabric dust collector that reclaims materials in a dry state, has been introduced by American Air Filter Co. It can be shipped in small sections and assembled at the installation site. The new Model B Amerjet reverse-jet fabric dust collector answers the need for a constant-volume fabric dust collector with advanced features, including low initial equipment cost, low installation cost, and minimum maintenance performance.

Adaptable to any application requiring the reclaiming of dry materials, the Amerjet can be used in cement plants, foundrys, mineral-grinding systems and compounding operations, all types of chemical processes, pharmaceutical plants, foods and fertilizer operations, and so forth. **—K-31**

High-Purity Gases

Properties, applications, and storage of ultrahigh-purity gases are covered in a 16-page booklet offered by Linde Co. Div., Union Carbide Corp. Linde high-purity gases—argon, neon, helium, krypton, xenon, radioactive gases, and special mixtures—have a variety of uses as protective atmospheres, refrigerants, insulators, radiation sources, and easily ionizable materials. In the monatomic gases no nitrogen is detectable by mass-spectrometer analysis; and, all other polyatomic gases are present in quantities less than 10 ppm. Moisture content is considerably less than 5 ppm.

Heat-conductivity, excitation-potential, and discharge-characteristic data are also included. **—K-32**

Armature-Banding Wire

A tin-coated stainless-steel wire, offering superior soldering characteristics when used for banding electric-motor armatures, is in production by Riverside-Alloy Metal Div., H. K. Porter Co. The outstanding uniformity of the tin coating assures a problem-free soldering operation.

A special analysis of Almet 302 stainless steel and a custom-built tinning line are used in producing an even coating of tin over the entire surface of the new armature-banding wire. This is essential because the finished wire must be soldered after being wound around the armature.

The wire can be supplied in any diameter from 0.031 to 0.105 in. It has been packaged on 75 and 100-lb reels. **—K-33**

Injection Oiler

Designed specifically for use with low-volume, short-stroke air cylinders, the new Watts Regulator Co. No. 608 injection oiler provides proper lubrication previously impossible with ordinary mist-type lubricators.

Installed in the pressure line between control valve and cylinder, the injection oiler delivers a controlled amount of oil direct to the cylinder through a capillary tube within the cylinder air-supply line. Oil is supplied to the injection oiler either from a standard lubricator placed ahead of the control valve or from a small oil reservoir under pressure. Also available in kit form with necessary fittings and tubing. **—K-34**

Adjustable-Speed Drives

Magnetic drives, in ratings from 75 to 4000 hp, have recently been added to the adjustable-speed-drive line of the Louis Allis Co.

The drives feature simplified design with few moving parts and provide versatile adjustable-speed performance over an automatically regulated 20:1 range.

They have been applied in a broad field of applications, including test stands, adjustable-frequency generating sets, paper-machine line shaft drives, extruder drives, rubber and paper calenders, wire-drawing machinery, pumps, blowers, and kiln drives.

The drive is based on a liquid-cooled magnetic-coupling design that features stationary field construction, bearings that can be relubricated without disassembly, and a unique cooling system. The cooling-system design permits a planned flow of air through the drive at all times and eliminates any possibility of bearing condensation and drive flooding. Since coolant does not contact the adjustable-speed member, "water drag" is eliminated and closer, more uniform speed regulation is obtained throughout its range.

Magnetic drives operate from a-c power and are offered as a complete drive package including drive unit with water controls, controller enclosure, and operator's station. Write for Bulletin No. 3650. **—K-35**

Aluminum Extrusions

Aluminum extrusions with unique interconnecting features offer design engineers a fresh approach to construction. Introduced by Reynolds Metals Co., a series of them may be used to make almost any continuous flat or curved surface. Because the interconnecting feature is an integral part of their shape, riveting, and welding are unnecessary at the joints.

Extrusions are tailored to specific jobs which means that metal is used where it is needed, and eliminated where it is not, to achieve substantial savings in both cost and weight. The added interconnecting feature opens many new end uses, because elimination of welding and riveting greatly cuts down fabricating time.

One of two basic interconnecting principles are used—interlocking and snap-lock. Interlocking extrusions were first used in trailer-truck floors. They offer a new answer to many old fabricating problems where disconnecting parts for reassembly are required.

Snap-lock extrusions were developed for permanent joining. They snap together forming a joint which can be as strong as the metal itself and stronger than either riveting or welding. They cannot be disassembled without actually deforming the metal. **—K-36**

KEEP INFORMED

NEW EQUIPMENT
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LATEST CATALOGS

Spray Enamel

High visibility fluorescent enamel for emergency safety marking may now be applied quickly with a convenient new type finger-tip spray dispenser available at local auto parts jobbers made by Du Pont Finishes Div., E. I. Du Pont de Nemours & Co. It is known as the Jet-Pak, and the aerosol sprayer consists of three elements—a can of propellent, an unbreakable-plastic spray head, and a glass jar which holds the thinned Pyralux fluorescent enamel.

Any of the Du Pont fluorescent colors—yellow, vermilion, orange, and red—can be used for quick stenciling of signs on white cardboard or other emergency use, where durability is a minor consideration. The aerosol spray is a fast, economical method of putting these hyperintense colors to work. —K–37

Electropneumatic Positioner

A new electropneumatic positioner, developed by Mason-Neilan Div., Worthington Corp., permits the advantages of electronic controllers and the power and smooth-throttling action of pneumatic-control valves to be combined. The device is a true positioner, directly comparing valve-stem position with controller-output signal, achieving dynamic response and positioning accuracy not attainable with any transducer-plus-pneumatic-positioner combination.

Added to the Mason-Neilan line as Model 8010, the unit features optimum performance plus simple installation and minumum maintenance. It employs an extra large, stabilized, magnetic-force motor to supply high force changes and a high-capacity air relay, for fast stroking speed. The electrical circuit is adaptable to all presently available electronic controllers.

The relay may be mounted in any of four positions to facilitate piping, and the balanced beam permits installation of the valve in any position without shift in calibration. Stroke adjustment can be made through a plate-covered aperture without exposure of any wiring.

Model 8010 is available for 3 to 15-psi or 6 to 30-psi valve-spring ranges, or for split ranging. Standard-stroke ranges are from $^3/_8$ to 3 in. and from 2 to 4 in. Other ranges can be provided. It may be used with either direct or reverse actuators.

Performance data on Model 8010 are: Open-loop gain, approximately 100; linearity, within ±1 per cent of full stroke; repeatability, within 0.2 per cent; load sensitivity, output-pressure change of 1.2 psi per 0.1 per cent of full-stroke offset; Supply-pressure effect, ±1 per cent of full stroke for ±5-psi change from 20 psi. —K–38

Hydraulic Cylinders

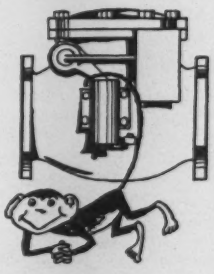
A new line of power cylinders for use in medium-high-pressure hydraulic service has been announced by the Power Cylinder Div. of Hannifin Co. Designed for use with 1000-psi pumps, the Series L cylinders have been termed "The Thousand Pound Line" and are available in bore sizes from 1- through 8 in., all designed to operate at full 1000-psi hydraulic pressure. They are of square-head and tie-rod design, and provide case-hardened and hard-chromium-plated piston rods as standard. Drip-free rods and leak-proof ports are also featured, and fourteen different mountings available. —K–39

CUSHIONS ON LAST 5% OF STROKE

G-A *Cushioned* Swing Check Valve

Don't monkey with hammer and shock in your water lines. Use a G-A Cushioned Swing Check Valve with the special cushion chamber that eases it through the last 5% of its stroke. Let the valve with the built-in "pillow" protect your equipment.

Write today for Bulletin W-1A.



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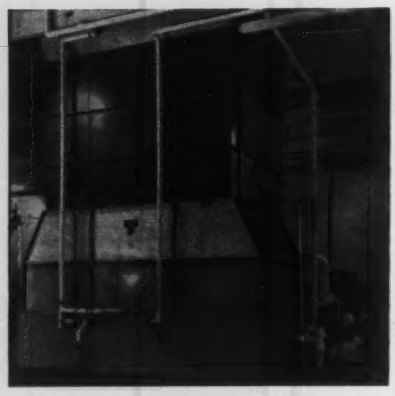

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You can cool and hold accurately the temperature of all fluids, condense vapors, cool water, oils, solutions, intermediates, coolants for mechanical, electrical or thermal processes. You have a closed system free from dirt. You have solved all problems of water availability, quality or disposal, maintenance expense is low.

You may apply this to solvent recovery, vacuum systems controlling reactions, condensing distillates, cooling reflux products.

For more information, write for Bulletins 120, 124, 135. Address Dept.

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Niagara District Engineers in Principal Cities of U. S. and Canada

KEEP INFORMED

BUSINESS NOTES
NEW EQUIPMENT
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Inclined-Tube Manometers

King Engineering Corp. announces a line of inclined-tube manometers of high sensitivity for measuring pressure, vacuum, differential pressure, or flow in industrial applications where the higher cost of a laboratory-type instrument would not be justified.

With these manometers, the indicating tube is inclined rather than vertical, so that for any given pressure change, the liquid in the tube moves a distance several times as great as the change in height. Thus, compared to a vertical-tube manometer of the same range, the scale divisions are much farther apart, and the instrument is much more sensitive and easier to read.

These new manometers are available with scale lengths of 20 to 60 in. and with vertical ranges of 2 to 20 in. in most sizes. Maximum working pressure is 350 psig. Each instrument has a scale precisely calibrated to the particular manometer, and a built-in spirit level for proper installation. Write for Catalog 2008. —K–43

Adjustable-Speed Drives

An entirely new Polydyne series of packaged adjustable-speed drives has been introduced by the General Electric Co.

It represents the first mechanical adjustable-speed drives to be offered by the company's Gear Motor and Transmission Components Dept., long a manufacturer of complete lines of integral and fractional-horsepower gear motors, speed reducers, and special-purpose transmissions.

Polydyne drives, available in a wide range of outputs and speed ratios, operate on the proven principle of V-belt-connected, adjustable pitch pulleys.

Belt replacement is enhanced by a design which assures adequate internal clearances, undisturbed controls, and automatic and immediate belt tensioning. These features combine to make the belt-changing operation quick and easy.

The actuating force for control is directed through an "equalizer" which prevents any binding or sticking of the speed-control function. Control location is flexible and capable of quick relocation in the field.

Polydyne drives are being offered from 1/4 through 25 hp a-c in output speeds from 5 to over 4000 rpm, with standard speed variations of 2, 3, 4, and 5 to 1. Maximum Speed Variation (ranging from 6 to 1 at 25 to 10 to 1 at 1 hp ratings and below) is also available.

Accessories include remote mechanical, remote electric, and pneumatic-actuated controls. Remote, electric speed-indication systems, available in standard accuracies of 2 and 3 per cent full scale, feature the new General Electric DO-91 panel instrument, DB-18 instrument, and AC tachometer generator especially adapted for the new Polydyne drives. —K–44

Packaged Boilers

A new line of fully automatic Husky series packaged boilers is announed by Western Boiler Co. Sizes range from 10 to 125 boiler hp with models for light oil, natural gas, or combination gas light-oil operation.

The units are of compact three-pass design. A single motor drives both fan and oil pump. Forced draft eliminates the need for tall stacks or other auxiliary draft equipment. Complete operating and flame-safeguard controls are standard in enclosed cabinet. Low-fire start is standard, but full modulation on both oil and gas is available. —K–40

Solenoid Valve

A single-solenoid, two-position, four-way ASCO solenoid valve having 1/4-in. orifices is available from Automatic Switch Co.

It has a forged-brass body (available in 1/4 or 3/8-in. pipe connections) and poppet-type seats and disks. The main valve disks are power driven in both directions without the aid of return springs. Practically instantaneous in operation, the valve will operate on air, water, or hydraulic oil at pressures up to 250 psi and 212 F.

A combination of metal-to-metal and resilient seating provides absolute tight seating on air and liquids, without grinding or adjustments. The valve can be mounted in any position. It is available in all standard voltages and may be supplied with solenoid enclosures to suit any application. —K–41

Ball-Bearing Splines

An "on-the-shelf" line of standardized ball-bearing splines has been introduced by the Saginaw Steering Gear Div., General Motors Corp. Production of the relatively low-priced, standardized models was made possible through extensive retooling. The splines are produced in six sizes, ranging from 3/8-in. to 3-in. diam.

Use of the Saginaw ball-bearing spline assembly is indicated in applications requiring low resistance to linear motion, long trouble-free service life, and minimum radial lash. A gothic-arch race configuration produces an end product with a consistently high degree of uniformity and allows preloading of the inner to the outer member when necessary.

The spline can be fitted with integral gears or sprockets, clutching devices, trunnions, flanges, and bearings.

Material savings in weight accompanied by much longer life are a product of the high efficiency of the splines. They operate with far less friction than conventional splines, and are able to withstand extremely high rotational loads with minimum wear. —K–42

For Consulting Engineers

Turn to Page 168

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1	14, 15	25	132	145	161TL
2	16	26	133	146L	161R
4	17	123	134, 135	146R	162
6, 7	18	124	136	147	169
8, 9	19	126	137	149	171
10	20, 21	127	138	151	172
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K-1	K-11	K-21	K-31	K-41	K-51	K-61	K-71
K-2	K-12	K-22	K-32	K-42	K-52	K-62	K-72
K-3	K-13	K-23	K-33	K-43	K-53	K-63	K-73
K-4	K-14	K-24	K-34	K-44	K-54	K-64	K-74
K-5	K-15	K-25	K-35	K-45	K-55	K-65	K-75
K-6	K-16	K-26	K-36	K-46	K-56	K-66	K-76
K-7	K-17	K-27	K-37	K-47	K-57	K-67	K-77
K-8	K-18	K-28	K-38	K-48	K-58	K-68	K-78
K-9	K-19	K-29	K-39	K-49	K-59	K-69	K-79
K-10	K-20	K-30	K-40	K-50	K-60	K-70	K-80

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NEW EQUIPMENT
BUSINESS NOTES
LATEST CATALOGS

Check Valve

A unique Circle Seal Products Co. engineering development positively assures O-ring reliability against high-pressure split-second surge flows. Faster-acting solenoid and other rapidly actuated valves in high-pressure systems have created new problems which the 200-series check valve has successfully eliminated.

Fool-proof O-ring retention is assured by an ingenious cage device which positively restrains the O-ring from washout—a problem common in other soft-seated valves. Heavier, more rugged construction of the body provides additional protection against abuse and failure.

Dead-tight sealing and chatter-free operation derive from the design. The valve provides proper cushioning combined with low pressure drop and dependable, sensitive, leak-free reseating. These features make the 200-series valve suitable for use in a wide variety of high-pressure gas or liquid services where extreme surge flows are encountered.

Bodies of brass, aluminum, steel, and stainless steel are available and range in size from 1/8 to 2-in. pipe size. —K–45

Liquid Meter

A Model BNV Chemical Liquid Meter, especially designed for small flows, has been added to the Buffalo Meter Co. line of Niagara Liquid Meters. Of 3/4-in. size, it supplements the 1 and 2-in. sizes previously manufactured.

Internal works will be constructed of Type-316 stainless, but the measuring piston can be of any of a variety of materials as required. Outer casing will be constructed of stainless steel, carbon steel, or cast iron.

Available with either threaded or flanged connections, and with a full range of register types, this new meter will measure a wide variety of chemical liquids including most acids, alkaline solutions, deionized water, and edible oils. —K–46

Miniature Positive Clutch

A miniature positive clutch No. CT 14, has been developed by Stearns Electric Corp. Designed for instrument applications where a minimum space is available for the clutch, it has positive-acting crown teeth which are magnetically engaged and spring released. The teeth are pitched for easy engagement at very low rpm, followed by smooth acceleration to drive the load.

Over-all length of the 1 1/2-in. diam clutch is 3/4 in. It develops 80 oz-in. torque and may be wound for 28 volts d-c. A sheave may easily be mounted on the driven hub which also serves as an armature. Other types of mountings are with worm gears and spur gears. —K–47

Wrench

The Socket Screw Div., Bristol Co. is marketing the Wrenchking, an open-end wrench with ratcheting action manufactured by Royal Tool Co.

The unique feature of the wrench is a spring-activated pawl which provides better gripping action against a nut and releases for ratcheting action. In operation, the pawl slides against the flat jaw of the wrench to seat the wrench against the nut; locks the nut in the wrench; releases the nut for ratchet action; and then relocks it in the wrench. —K–48

BUSINESS NOTES

Distributor Appointed

The industrial division of Barry Controls, Inc., has been appointed national distributor for the complete line of industrial mountings for vibration, shock, and noise-control manufactured by U. S. Rubber Co.

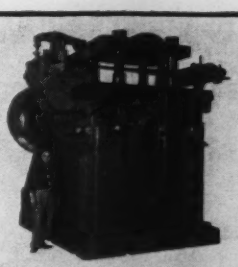
Barry Controls, Inc., one of the nation's leading manufacturers of mounting systems and mechanical dynamic components for industrial applications, maintains corporate offices, design-engineering staff, and a manufacturing division at Watertown, Mass., and western manufacturing facilities at Glendale, Calif. Other subsidiaries and divisions are in Los Angeles, Chicago, Detroit, and Groton, Mass.

The association of Barry Controls and U.S. Rubber will provide expanded services and facilities to companies with vibration, shock, and noise-isolation requirements. Barry maintains an extensive field engineering organization.

Plant Expansion

Barber-Colman Co., Rockford, Ill., will expand plant facilities to meet increasing demands for their automatic controls, air-distribution products, overhead doors, and industrial instruments. The addition to the Park Plant, situated on 50 acres at the northern edge of Rockford, will increase the present plant area by approximately 170,000 sq ft.

General architects for the project are Hubbard and Hyland of Rockford. E. R. Gritschke and Associates of Chicago will design mechanical and electrical installations, including air conditioning, heating, ventilating, plumbing, lighting, and wiring.



"WE RECOMMEND LUBRIPLATE FOR HENRY & WRIGHTS"

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The Hydraulic Press Mfg. Co.
A Division of Koehring Co.
of Mount Gilead, Ohio

"We have had excellent results with LUBRIPLATE in our new double crank design Henry & Wright Dieing Machines which we recently acquired from Emhart Mfg. Co., Hartford, Conn. This follows the same fine results Emhart had with LUBRIPLATE in single crank Henry & Wrights for many years. In the Operating Manual that goes with every new Henry & Wright machine, you will find that we recommend LUBRIPLATE."

REGARDLESS OF THE SIZE AND TYPE OF YOUR MACHINERY, LUBRIPLATE GREASE AND FLUID TYPE LUBRICANTS WILL IMPROVE ITS OPERATION AND REDUCE MAINTENANCE COSTS.

LUBRIPLATE is available in grease and fluid densities for every purpose . . . LUBRIPLATE H. D. S. MOTOR OIL meets today's exacting requirements for gasoline and diesel engines.

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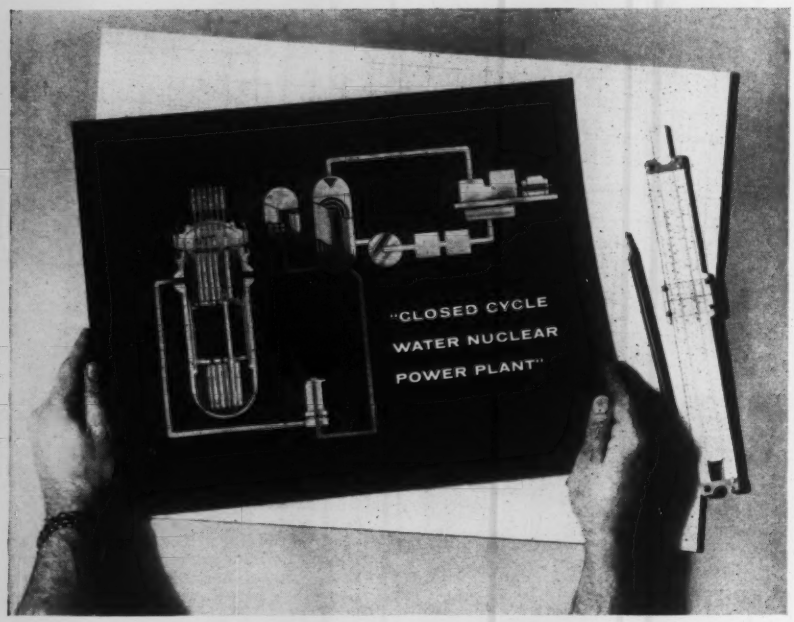
NEW PROFESSIONAL GROWTH OPPORTUNITIES for PHYSICISTS, SCIENTISTS, ENGINEERS, (Metallurgical, Chem., Mech.)



330-1 REACTOR—With a reactor vessel and closure head weighing 418 tons, standing 41 feet high and having a 12 foot ID, the engineers and scientists at the Commercial Atomic Power Department visualize a power system that can produce 360 gross electrical MW. This is the scope of planning now in progress at APD. You can take part in this or other phases of the rapidly expanding commercial nuclear power field where your talent can be applied to the problems of making nuclear energy competitive with other forms of power.

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Scientists and Engineers who want to make the transition to the expanding field of commercial atomic power with a company that is a leader in the field, write to: Mr. C. S. Southard, Westinghouse Atomic Power Division, P.O. Box 355, Dept. W-86, Pittsburgh 30, Pa.

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BUSINESS NOTES
NEW EQUIPMENT
LATEST CATALOGS

Merger

Dudek & Bock Spring Mfg. Co. has acquired the Advance Spring Corp. and moved the company's manufacturing facilities to an adjacent building. The combined facilities at 4104 W. Grand, Chicago, Ill., have a total area of 72,000 sq ft. Gross sales last year, of the two companies which now employ over 300 persons in the manufacture of wire forms, springs, and metal stampings, were $5 million. The merger expands Dudek & Bock's sales operation throughout the country and into foreign markets such as South America and the Middle East.

Electromechanical Laboratories

New electromechanical laboratories have been opened by U. S. Steel at the company's Monroeville, Pa., Research Center.

Electromechanical research will cover work on projects ranging from problems in material handling to the development of automatic devices for controlling metallurgical and chemical properties, temperature of furnaces, thickness of product, and so forth.

Methods will be developed for the continuous sampling and analysis of iron ore and automatic measurement of its weight and rate of flow.

The Research Center's pilot blast furnace, scheduled for completion in the fall, will be used to clear up many of the mysteries of the complex ironmaking process.

In the area of inspection, new or improved quality-guarding devices are being sought.

Electromechanical Research is a division of the Research Center's Applied Research Laboratories. There are also Fundamental Research facilities at Monroeville. Together they employ 1100 research workers and their supporting personnel and encompass more than 580 different research projects.

LATEST CATALOGS

Heat-Transfer Units

Higher operating pressures and faster heat up are features of the new multizone Platecoil described in Bulletin PD1 available from Tranter Mfg., Inc. Platecoils are metal sheets with a piping arrangement embossed on them. The pass configuration of the multizone model has been redesigned to greatly improve steam distribution for greater effective heat transfer. —K-49

KEEP INFORMED

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Rotary Gear Pumps

Six-page Bulletin G-3 describes the Sier-Bath Gear & Pump Co., line of internal and external bearing-type Gearex pumps to handle lubricating and nonlubricating materials in viscosities up to 5,000,000 SSU, capacities up to 650 gpm and pressures up to 350 psi. Bulletin includes data on horizontal models, vertical submerged-pump type, vertical dry type, high-temperature models, jacketed-body and other designs, plus engineering details of construction dimensions, and capacities. **—K–50**

Air Presses

A new line of precision-built, single-acting air presses recently developed by Niagara Machine & Tool Works, is fully described in four-page Bulletin 85.

Consisting of 28 models, the new line is built around four basic press sizes ranging from $^1/_2$ to 2-ton capacities at 85 psi. With six optional air and electrical control systems available, it offers a wide choice of machines for punching, swaging, staking, upsetting and imprinting operations, as well as seating and removal of close-tolerance bearings and bushings. Featured is a diaphragm-type, frictionless air cylinder which contributes to maintenance-free service and operating economics.

Other features described include electronic timers, speed-control valve, and pressure-limit control. **—K–51**

Maintenance-Safety Catalog

A new catalog, available from W. H. Brady Co., features 15 different products to aid safety directors and maintenance engineers in planning, and executing industrial maintenance and safety-identification programs.

Proper marking of piping systems, identification of plant wiring and electrical equipment, correct lubrication of machinery, and marking of hazardous plant areas and equipment are covered. **—K–52**

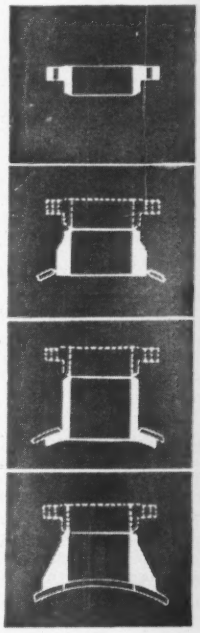
Electric Motors

An eight-page Motor Selector announced by Howell Electric Motors Co. is a quick reference to the complete motor and generator lines available through the consolidation of Howell with Ohio Electric Mfg. Co., Kingston Conley, Inc., and Leland Ohio Electric Co.

The a-c motors range from $^1/_{40}$ to 300 hp and include a complete line of standard motors in a broad range of voltages, speeds, mountings, and enclosures; as well as designs for a wide variety of special applications which include cranes, hoists, elevators, machine tools, oil burners, gasoline and water pumps. **—K–53**

LENAPE OFFERS A NEW CONCEPT IN PRESSURE VESSEL CONNECTIONS

Now—by combining a Lenape ASA bolt flange which is a short seamless welding neck and your choice of three seamless bodies, you get optimum reinforcement, design flexibility and economy.



SPECIAL ASA BOLT FLANGE

Simple, low cost attachment, with easier alignment and orientation. You can choose different materials for body and flange, as well as length with unmatched economy in lengths over 12″.

SEAMLESS CYLINDER EXTENSION

Superior to pipe or rolled plate. No seams. Built-in reinforcement. Choice of length and thickness.

TYPE C INTERNAL REINFORCING NOZZLE

Separate bolt flange makes more efficient internal reinforcement possible.

TYPE D EXTERNAL REINFORCING NOZZLE

External attachment with massive reinforcement.

All of these are available in 300 to 900 lb. ASA standards.

Full details and specifications are given in the new 96-page Lenape Catalog. Write for your copy.

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LENAPE HYDRAULIC PRESSING & FORGING CO.
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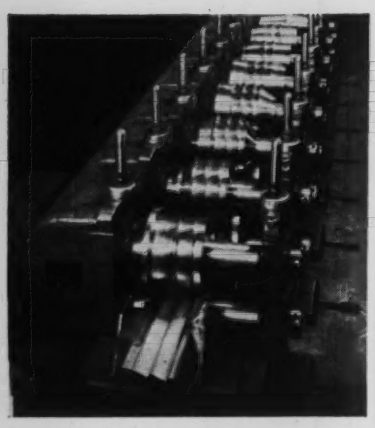

Yoder Roll-Forming Equipment mass-produces shapes accurately, economically

Yoder Roll-Forming Equipment, even with part-time operation, can effect significant savings in many metal working applications and industries. Shapes, simple or complex, can be quickly and economically produced the Yoder way from a wide variety of flat-rolled coated or uncoated stock ... in thickness up to ¾ inch ... in speeds up to 50,000 feet per day.

Yoder engineers flexibility and precision into metal forming operations. For example: many basic shape modifications, such as coiling, welding, notching, ring-forming, perforating, and cutting to length can be simultaneously accomplished with little or no additional labor cost.

Yoder also makes a complete line of Rotary Slitters and Pipe and Tube Mills. Profit from Yoder's years of engineering and service experience, contact your local Yoder representative or send for the Yoder Roll-Forming Manual.

This fully-illustrated 88-page book clearly discusses every important aspect of Yoder Roll-Forming Equipment and methods ... it's yours for the asking!

THE YODER COMPANY
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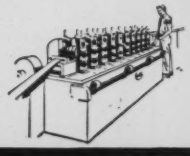

ENGINEERING YODER MANUFACTURING
COLD ROLL FORMING MACHINES

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NEW EQUIPMENT
BUSINESS NOTES
LATEST CATALOGS

Grinding Wheel for Welding

"Grinding Wheels for the Welding Trade" issued by Norton Co. describes the uses and properties of each type of grinding wheel used in welding. Photographs and tables amplify the text of the 14-page booklet to help the user determine the correct wheel for every job. A net price supplement is included. Ask for Form No. 1724. **—K-54**

Cast Alloys

Lebanon Steel Foundry's new Reference Chart contains 55 of the more widely used cast alloys in the carbon, low-alloy, and stainless groups; also nickel and Monel. In addition to all standard data such as composition physicals, and so forth the 1960 chart contains a section for design applications of each steel alloy. **—K-55**

Plant Equipment

Ingersoll-Rand Co. has issued a booklet, Form 223, entitled "Products For The Plant." Standard reciprocating, axial-flow, and centrifugal air compressors, centrifugal pumps; steam condensers; steam-jet ejectors; vacuum pumps; air hoists; and air and electric tools are all covered in this eight-page booklet. **—K-56**

Elastomers

A six-page bulletin, No. 902, describing capabilities in design of custom-built elastomers has been issued by Lord Mfg. Co. A two-page chart lists the general properties of the 10 major elastomers, describing their origin and composition and that of natural rubber. Physical and chemical properties, processing properties, and environmental resistance characteristics are given. **—K-57**

Mechanical Vibrating Conveyers

Four types of mechanical-vibrating conveyer equipment, to meet a full range of applications, are described in the 60 pages of Catalog 954 issued by the Jeffrey Mfg. Co. The HMV (Heavy Duty) conveyer is designed to handle large capacities that require a heavy rugged machine capable of continuous operation under the most severe conditions of service. The TMV (Twin Mass) conveyer is a dynamically balanced unit for low-cost maintenance-free operation. The MMV (Medium-Duty Medium-Weight) conveyer is built in 12-ft-long sections and is for medium capacities which require a substantially built unit. The LMV (Low-Capacity Low-Height) conveyer, also sectional, is for use in restricted areas.

Information is included on other Jeffrey equipment such as vibrating feeders, weigh feeders, dryers, coolers, barrel packers, screens, and magnetic separators. **—K-58**

Milling Machines

Catalog No. M-2110, covering the Cincinnati Milling Machine Co. line of Toolmaster milling machines is available. Complete specifications, dimensional data, and operational features of the four models which differ only in spindle-carrier design are included in the 24-page publication. **—K-59**

Rotary Pumps

Rotary-pump technical data is presented in an easy-to-understand way in a selection manual issued by the Deming Co. Liquids are grouped into eight classifications according to viscosity each with its own selection table. Many other liquids of the same viscosity are listed on facing pages. This makes it possible to make a startlingly fast, accurate rotary pump selection by matching the liquid to the pump. **—K-60**

Pressure Regulator

Now available from OPW-Jordan is an eight-page Catalog J160-1 which gives up-to-date information on the complete line of sliding-gate pressure regulators. Self-operated, pilot-operated, solenoid-operated, and back-pressure regulators are described. The regulators are designed for use on steam, water, air, oil, gas, or corrosive chemicals. The sliding-gate seat provides self-cleaning, self-lapping action, and straight-through flow. **—K-61**

Water Tanks

Chicago Bridge & Iron Co. has issued "Tanks that Advertise," a four-page brochure describing special elevated water-storage tanks built as king-size replicas of consumer products. The eye-catching steel structures combine efficient water storage and sales promotion. **—K-62**

Pressure-Measuring Elements

The U. S. Gauge Div. of American Machine and Metals, Inc., announces a 16-page catalog, No. 900, titled "Pressure Measuring Elements," covering diaphragm and Bourdon-tube elements.

Materials and performance characteristics are listed for both conventional-capsule and nested-capsule types. Complete data, such as dimensions, travel, rated and maximum pressure, linearity, spring rate, and deflection rate are listed for elements made from Ni-Span-C which provides an almost constant spring rate over a temperature range of −50 to +200 F.

Bourdon-tubes specifications and materials and the dimensions of fixed and free end fittings for diaphragm elements are also included. **—K-63**

KEEP INFORMED

BUSINESS NOTES
NEW EQUIPMENT
LATEST CATALOGS

Seamless Tubing

The manufacturing capabilities of fine seamless tubing from a broad range of ferrous and nonferrous metals and alloys are described in a 12-page catalog issued by Uniform Tubes, Inc. Sizes from 0.005-in. OD, wall thicknesses, tolerances, properties and applications of various alloys are listed. —K–64

Tungsten Alloys

Kennametal heavy tungsten alloys, with densities of 17 to 18.5 grams per cc are presented by Kennametal Inc. in a new eight-page bulletin. Properties, applications, fabrication methods, and available sizes and shapes of three grades are given. Kennametal engineering service and facilities are also offered in applying the materials. —K–65

Replacement Piston Rings

Comprehensive and up-to-date set-up sheets for replacement piston rings designed specifically for virtually all of the popular industrial engines have been published by the Metal Products Div. of Koppers Co.

These set-up sheets were made in order to save owners and operators of industrial engines needless expense and delay in problems connected with replacement rings. Requests for this information should specify the make, model, and type of service (diesel, natural gas, dual fuel, etc.). Koppers' engineers will then forward the recommended set-ups promptly. —K–66

Heavy-Duty Coils

A 44-page bulletin, B-1518, describes the American-Standard line of heavy-duty coils for steam, steam distribution, and hot water.

Among the unique data are complete condensate rating information for both saturated and superheated steam and typical material specification for coil applications involving temperatures and pressures which exceed standard-coil construction limits. —K–67

Copper-Clad Laminates

Technical information on copper-clad laminates, composite sheets made by facing selected base-laminated plastics with copper foil on one or both sides, is given in Data Sheet No. 8-1A issued by Taylor Fibre Co.

Printed circuits can be produced with copper-clad laminates by any conventional method—photoengraving, silk screen, or offset printing. The copper surfaces are free of pinholes, pits, or lead inclusions, thereby eliminating open circuits and high resistance points. The special finish on the copper accepts all acid resists uniformly, and has excellent solderability. —K–68

IN THE NEW CALIFORNIA BANK BUILDING

PIPING SYSTEMS ARE SAFE and SILENT!

Silent Check Valves operate instantly when flow reversal starts or when flow is zero. In this handsome new Los Angeles structure, as in hundreds of other major buildings — surge pressures are controlled, troublesome water hammer is eliminated.

Write for Bulletins: No. 659 on Pressure Loss Tests . . . No. 654 on Valves . . . No. 851 on Cause, Effect and Control of Water Hammer.

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2 Gateway Center • Pittsburgh 22, Pa.
Our 74th Year • 1886-1960

Tools

Twist drills, reamers, end mills, countersinks, counterbores, carbide tools, tool bits and special tools are among the many categories of tools covered in Chicago-Latrobe's new Catalog 60. —K–69

Axial Piston Pump

An eight-page brochure, Bulletin 203, on the use of Denison axial-piston pumps at pressures up to 5000 psi has been published by the Denison Engineering Div., American Brake Shoe Co.

The company's 30, 40, and 60-series pumps, in both constant and variable-volume models are discussed. Performance and torque curves are illustrated, as well as the axial-piston techniques of pumping. A ratings chart for both pumps and fluid motors, ranging in maximum pressures from 3500 to 5000 psi is included. Accessory valves and controls to be used in 5000 psi systems are also reviewed. —K–70

Laboratory and Test Instruments

A 16-page Folder E6 describes the Leeds & Northrup Co. convenience-styled line of laboratory and testing instruments. It contains specifications, application information, and prices of six different portable potentiometers, two d-c galvanometers, an a-c and a d-c null detector, a guarded Wheatstone Bridge Facility, a Students' Potentiometer, a Universal Ratio Set and two electrolytic conductivity indicators. —K–71

Industrial Fans

A new industrial fan bulletin devoting some 17 pages to pertinent engineering data on industrial exhausting, blowing, and drying is available from General Blower Co., subsidiary of Ilg Electric Ventilating Co.

The engineering handbook section includes air-volume tables, corrosion data, drying temperatures for a variety of processing requirements, piping information, and many of the engineering facts needed for a mechanically sound exhaust and blower system. —K–72

Packaged Steam Generators

E. Keeler Co. DK Package Steam Generators are described in a detailed bulletin showing 24 sizes for gas, oil, or combination firing in capacities up to 60,000 lb per hr of steam with design pressures up to 600 psi. Also noted are special package boilers up to 100,000 lb per hr of steam and field-erected units up to 200,000 lb per hr of steam, for all fuels and all types of firing. —K–73

Lubricating Equipment

Condensed Catalog X-135 issued by Oil-Rite Corp., lists a variety of the most widely used lubricating equipment for handling a multitude of oiling jobs. Drawings, specification tables, and descriptive paragraphs round out the data on a complete line of oil cups, oiling systems, dispensers, valves, flow indicators, oil gages, and chain oilers as well as several new Oil-Rite developments. —K–74

KEEP INFORMED

NEW EQUIPMENT BUSINESS NOTES LATEST CATALOGS

Boosters

A simplified, easy-to-use handbook describing a complete new line of air-hydraulic, interchangeable boosters is now being distributed by S-P Manufacturing Corp.

Basic booster information as to its wide range of uses, single and double-pressure systems, proper tank selection, and production advantages of its air-oil circuits are fully detailed. —K-75

Thin-Sectioned-Bearing Applications

New concepts for applying thin-sectioned (1/4 to 1-in. width and cross section) large-bore 4 to 12 in.) ball bearings to equipment designs are presented in a 28-page engineering booklet available from the Kaydon Engineering Corp.

The weight, space, and cost-saving applications shown for the 90 standard sizes range from wire-twisting machines to paper-making machine press rolls, and from heavy-duty lathes to submarine periscopes. —K-76

Speed-Regulating Drives

The Louis Allis Co. has released Bulletin No. 101 that describes the operation and performance of the Louis Allis electronic Select-A-Spede drives.

These range in size from 3/4 to 4 hp, and feature a d-c motor powered from a compact, wall-mounted electronic control panel, which is controlled by an operator's control station. Adjustable voltage is applied to the motor armature from the panel which converts the a-c line voltage to a regulated rectified d-c source. The drive provides accurate speed regulation to within 3 per cent from no-load to full-load over an adjustable 8:1 speed range. —K-77

Brakes and Clutches

A short guide to brake and clutch friction application has been prepared by the Equipment Sales Div., Raybestos-Manhattan, Inc., which speeds the design solution for the brake or clutch application in question. It permits the selection of the right friction material or combination of materials. —K-78

Socket Screws

A technical reference on industrial socket screws issued by Standard Pressed Steel Co. is an 82-page textbook on the subject. It includes both standard catalog data and extensive design and performance information on this family of fasteners.

Titled, "Unbrako Socket Screw Catalog and Engineering Standards," the publication covers more than 2800 items, including socket-head cap screws, set screws, shoulder screws, button-head screws, pressure plugs, and socket-screw keys. Additional product lines reviewed are Unbrako square-head set screws and dowel pins. —K-79

Protected Motors

The performance of totally enclosed electric motors is claimed for Lincoln Multiguard Motors in which each individual coil wire is firmly sealed in tough auto-body-type plastic. Bulletin 6100.1 available from Lincoln Electric Co. describes this and other features of the motors which range from 1 to 125 hp. —K-80

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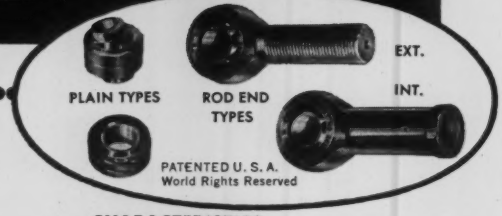
"Monoball"®
SELF-ALIGNING BEARINGS



CHARACTERISTICS

	ANALYSIS	RECOMMENDED USE
1	Stainless Steel Ball and Race	For types operating under high temperature (800-1200 degrees F.).
2	Chrome Alloy Steel Ball and Race	For types operating under high radial ultimate loads (3000-893,000 lbs.).
3	Bronze Race and Chrome Steel Ball	For types operating under normal loads with minimum friction requirements.

Thousands in use. Backed by years of service life. Wide variety of Plain Types in bore sizes 3/16" to 6" Dia. Rod end types in similar size range with externally or internally threaded shanks. Our Engineers welcome an opportunity of studying individual requirements and prescribing a type or types which will serve under your demanding conditions. Southwest can design special types to fit individual specifications. As a result of thorough study of different operating conditions, various steel alloys have been used to meet specific needs. Write for Engineering Manual No. 551. Address Dept. ME-60

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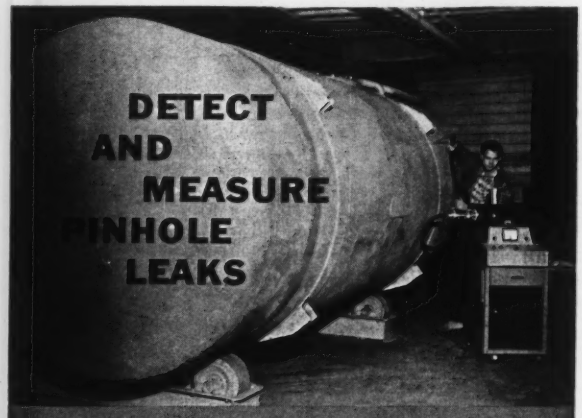

CEC's Helium/Mass Spectrometer Leak Detectors can help you locate and measure any leak you will need to find—certify Mil-Spec leak tightness—locate and measure flow rate of leaks so small that one cc of air at 14 lb. pressure would take more than 60 years to escape. These Leak Detectors are backed by CEC's 25 years of mass spectrometer experience. Two types are available—Mobile 24-110A, and Portable 24-210A, shown with mobile workstand. Call your nearest CEC sales and service office or write for Bulletins CEC 1838-X1 and 1830-X1.

Analytical and Control Division CEC
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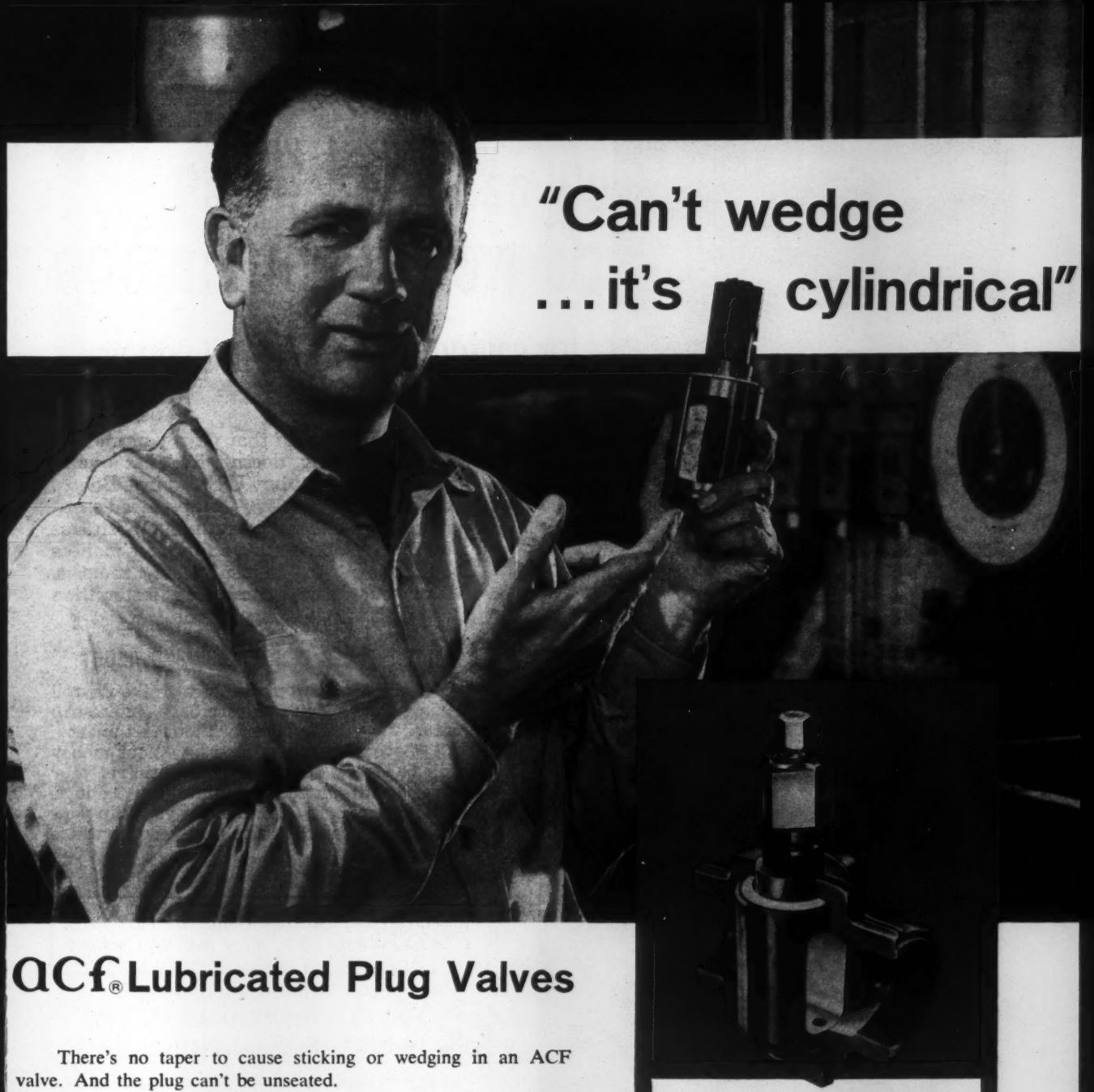

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acf® Lubricated Plug Valves

There's no taper to cause sticking or wedging in an ACF valve. And the plug can't be unseated.

The baseplate spring and line pressure hold the plug tight against the Teflon head seat gasket. All friction surfaces are constantly lubricated for easy quarter-turn operation and protection against corrosion.

Next time — and every time — specify ACF! *Available from leading suppliers everywhere.*

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DIVISION OF acf INDUSTRIES
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ACF semi-steel lubricated Plug Valves are available in rectangular, round, diamond, and V ports; venturi, multiport and steam-jacketed models.

Materials: steel, semi-steel, Ni-resist, carbon steel, bronze, aluminum.

Sizes: ½" through 30".

Working Pressures: 125 through 800 pounds.

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Dreams need some help. Saving with U.S. Savings Bonds is a good way to turn a dream into reality. The Payroll Savings Plan makes saving automatic. It doesn't let you forget—doesn't let you dribble it away.

Peace is what makes money worth having. Money buys a home, tools, toys—a good life in a world of peace. Take peace away and what do you have? The unspoken answer to that question is why many people buy Bonds.

Let the Government Pay You

for saving for something you want

An installment plan that pays you interest sounds surprising, doesn't it? That's what happens when you buy U.S. Savings Bonds. They now pay you 3¾% compounded semi-annually when held to maturity. With this new rate, $3 becomes $4 fourteen months faster than before—in just 7 years, 9 months. Make your dreams come true, faster than ever, with U.S. Savings Bonds.

ADVANTAGES WORTH THINKING ABOUT

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NOW every Savings Bond you own—old or new—earns ½% more than ever before.

You save more than money with U.S. Savings Bonds

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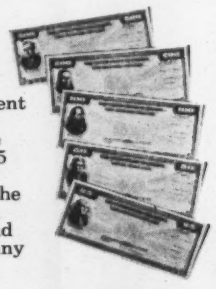
Collecting pictures of Presidents for fun and profit

A different U.S. President appears on each Bond denomination—George Washington on the $25 Bond (cost, $18.75); Grover Cleveland on the $100 Bond (cost, $75). Seriously, you'll be glad you're collecting as many Bonds as you can.



Pacific Process Pump **EXTRAS** bring **EXTRA PROFITS** to you!

EXTRA CORROSION ALLOWANCE—All Pacific Process pumps are custom-built with case casting thickness in excess of actual pressure-temperature requirements. This provides a liberal allowance for corrosion-erosion and a high safety factor.

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EXTRA LONG LIFE—Guided inlet flow reduces friction losses—insures minimum required NPSH. Dynamically, radially, and axially balanced moving parts eliminate vibration that would cause damage to rings, bushings, bearings, packing or mechanical shaft seals and excessive radial and thrust loads on bearings. Result—greatly increased availability for profitable operation.

Write for bulletins—please specify pump type.

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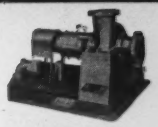
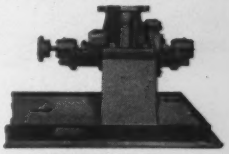


TYPE SVC
To 850°F.—25 to 3200 GPM
To 600 PSIG—To 650 DIFF. HD. FT.



TYPE HVC
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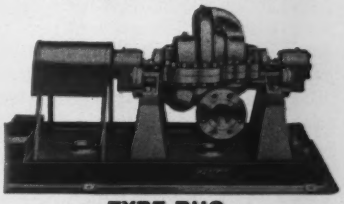

TYPE RHC
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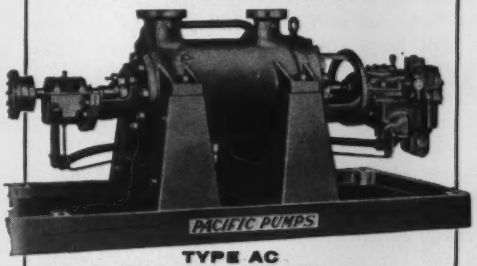

TYPE AC
To 850°F.—100 to 2500 GPM
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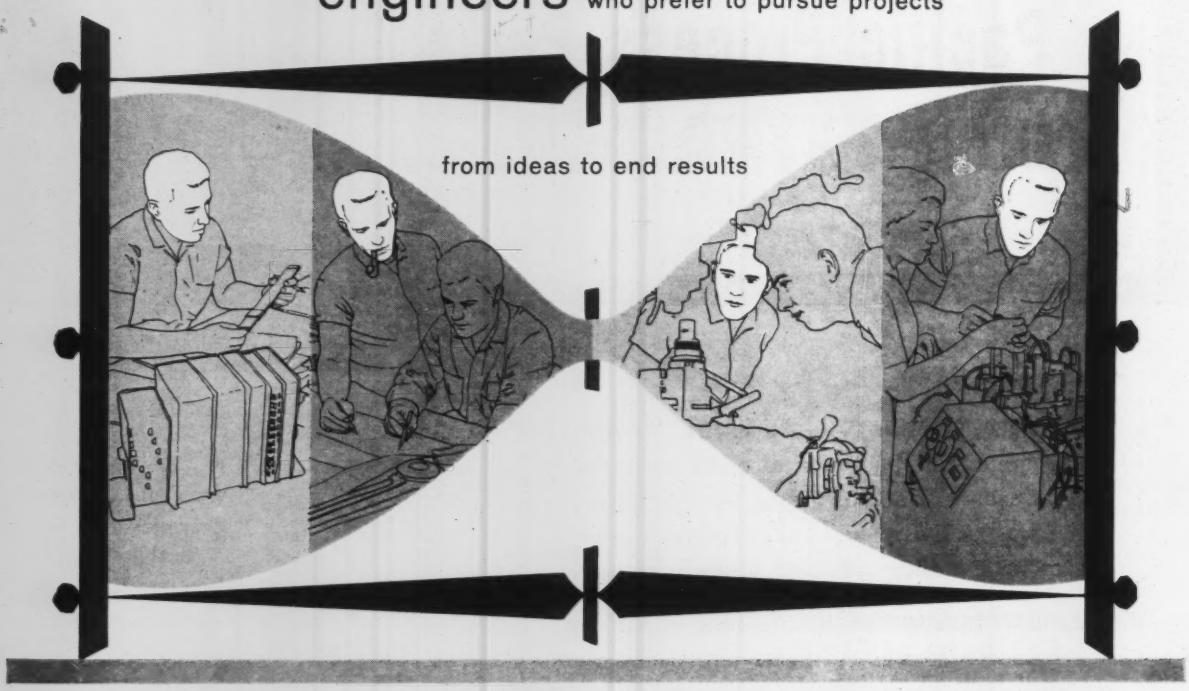

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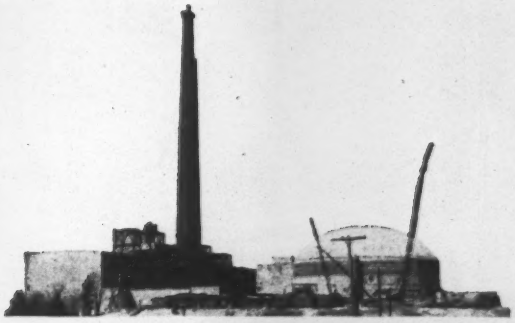

INDIAN POINT

Indian Point Station as it looked in April this year, showing some of the piping to be installed by Kellogg's Power Piping Division

NUCLEAR POWER PIPING BY KELLOGG

Construction progress at Consolidated Edison Company's Indian Point Station demonstrates how Kellogg's broad erection experience can take tomorrow's newest and toughest power piping requirements in stride.

At this unique 275 Mw nuclear steam electric generating station, Kellogg has a contract to manufacture, deliver, and to erect all stainless and carbon steel nuclear piping for the inside of the reactor sphere, and all power piping for the conventional portion of this plant. Kellogg also stress-analyzed the major portion of this piping. Much of the stainless piping will be manufactured in Kellogg's Williamsport plant.

The particularly rigid specifications of high quality and close tolerances required the assignment of a special engineering staff to the site. This staff plans, coordinates and supervises each step of Kellogg's erection assignment. One important phase entails over 2200 critical welds, most utilizing Kellogg's K-Weld technique. Another is the radiographic inspection of each weld, which Kellogg is undertaking with its own equipment and personnel.

Kellogg welcomes inquiries for its stress analysis, metallurgical, engineering, manufacturing and erection services.

POWER PIPING DIVISION · THE M. W. KELLOGG COMPANY

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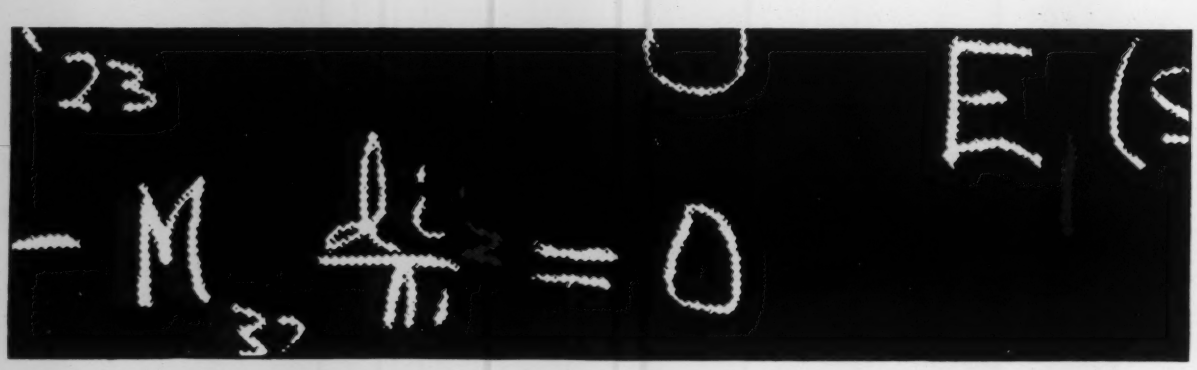
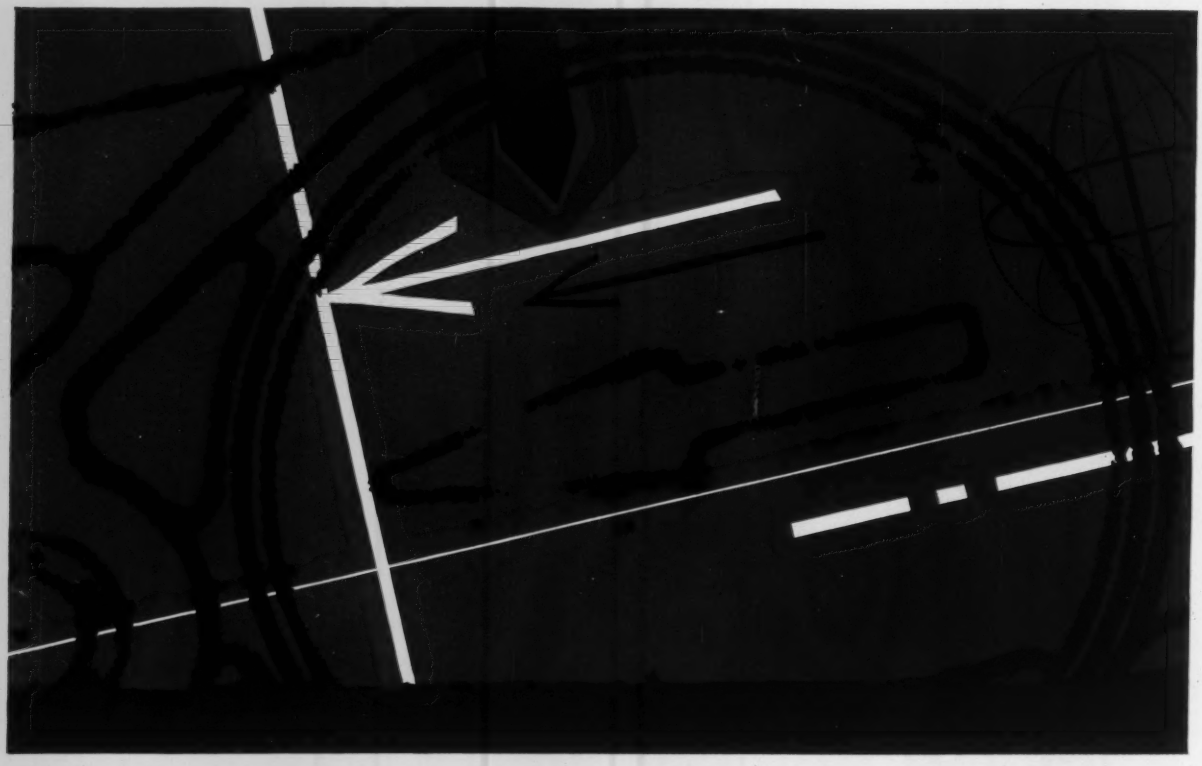


General Motors pledges

AC QUESTMANSHIP



AC Seeks and Solves the Significant—AC Design and Development is moving far ahead in new technology—the result of GM's commitment to make ever larger contributions to the defense establishment. AC plans to resolve problems even more advanced than AChiever inertial guidance for Titan / This is AC QUESTMANSHIP. It's a scientific quest for the development of significant new components and systems . . . to advance AC's many projects in guidance, navigation, control and detection / Dr. James H. Bell, AC's Director of Navigation and Guidance, sees this as a "creative challenge". His group takes new concepts and designs them into producible hardware having performance, reliability and long life. He strongly supports the fact that an AC future offers scientists and engineers "a great opportunity to progress with a successful and aggressive organization" / If you have a B.S., M.S., or Ph.D. in the electronics, scientific, electrical or mechanical fields, plus related experience, you may qualify for our specially selected staff. If you are a "Seeker and Solver", write the Director of Scientific and Professional Employment, Mr. Robert Allen, Oak Creek Plant, 7929 So. Howell Ave., Milwaukee, Wisconsin.

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Glass-lined Grinnell-Saunders Valves, with Teflon Diaphragms, on benzene hexachloride lines at Diamond Alkali's Greens Bayou, Texas, plant. Hundreds of other Grinnell Diaphragm Valves are used in other areas of the plant.

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For further facts about Grinnell-Saunders Valves, see Grinnell's insert in Chemical Engineering Catalog, or Sweet's Plant Engineering File — or write directly to Grinnell Company, Providence 1, Rhode Island.

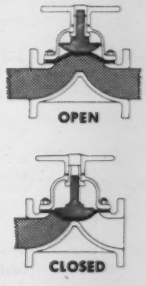

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Fig. 525

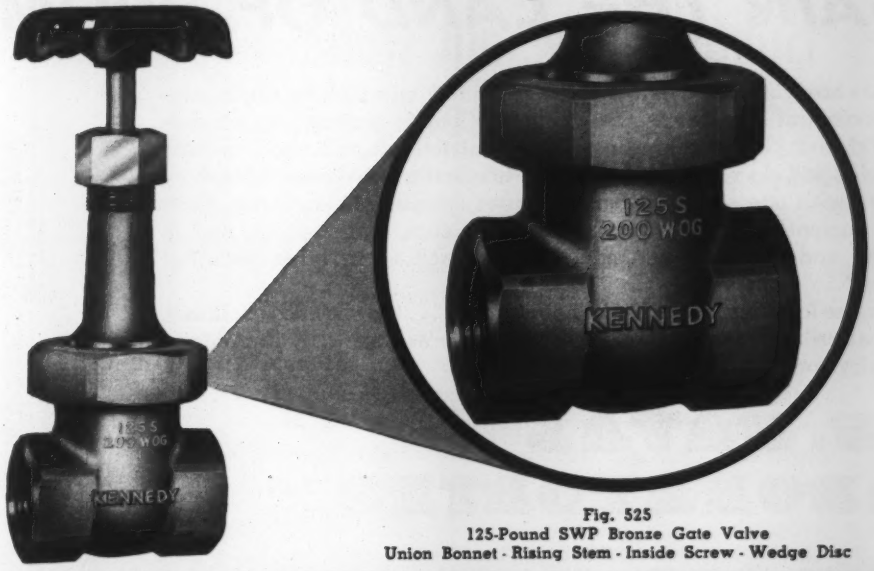
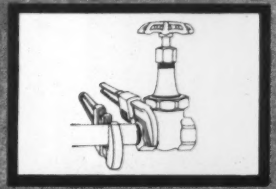
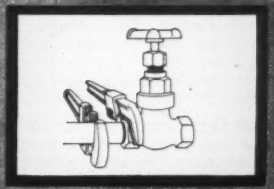


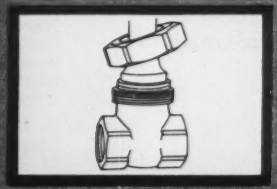
Fig. 525
125-Pound SWP Bronze Gate Valve
Union Bonnet - Rising Stem - Inside Screw - Wedge Disc



KENNEDY'S wider hex ends are blended into the body, making the body and hexes one rugged unit. Thus extreme wrench pressure is absorbed through the entire rigid valve body.



On conventional valve body, hex ends protrude from the body and are connected by thin body wrists. This area, under severe wrench pressure, can distort and cause disc seating trouble.



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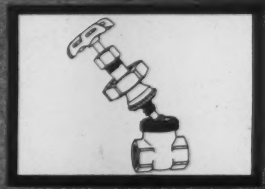

Union Bonnet Fig. 525 can be easily disassembled into its component parts to installation in otherwise inaccessable places in existing lines or in new installations where space is limited.

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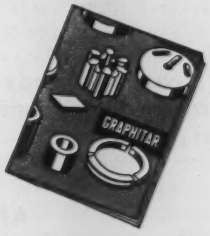

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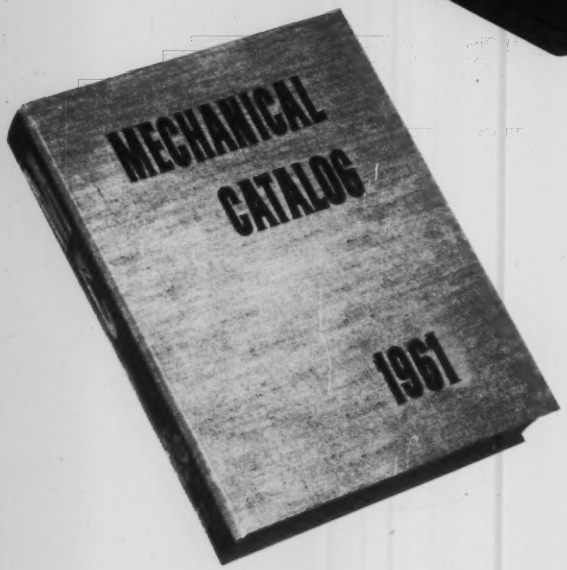

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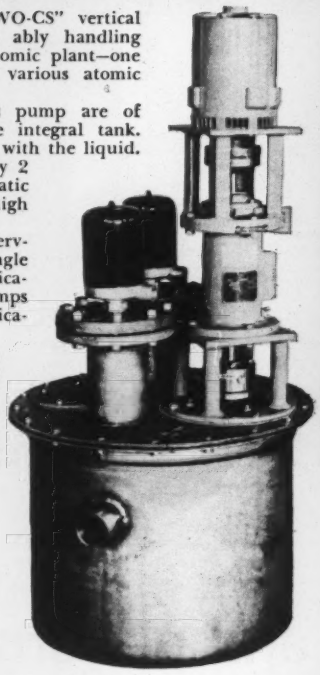

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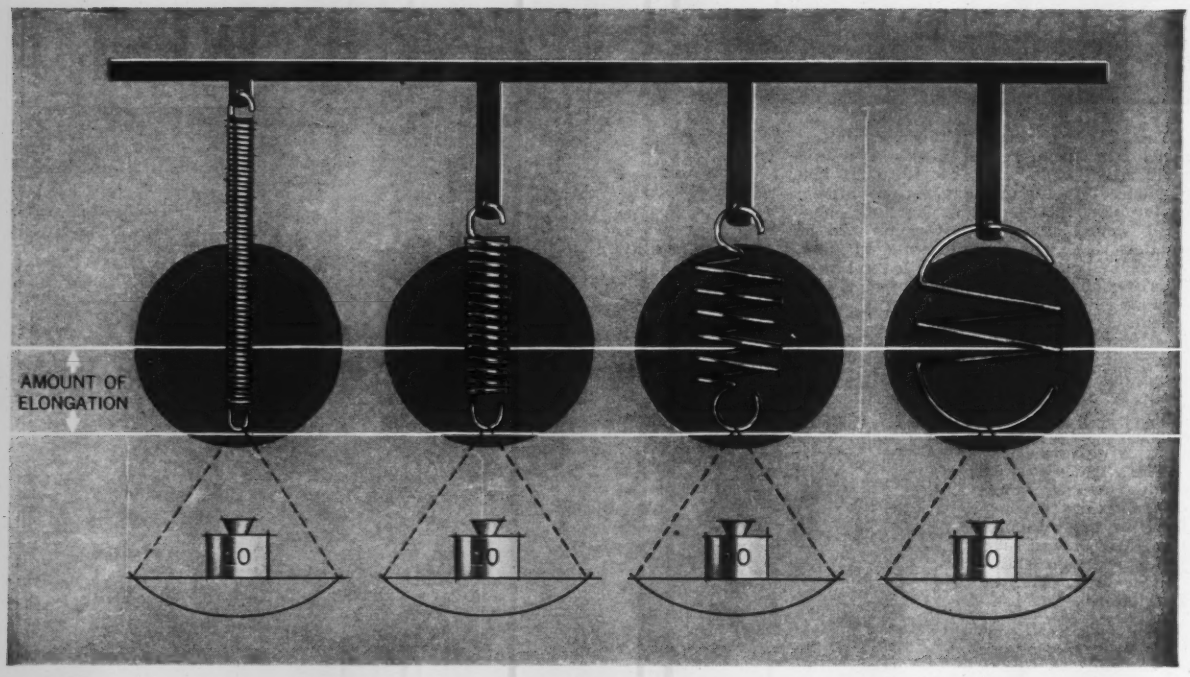

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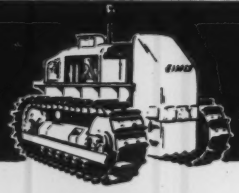

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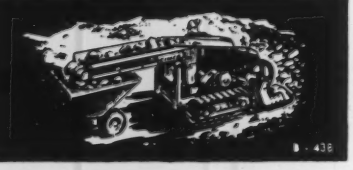

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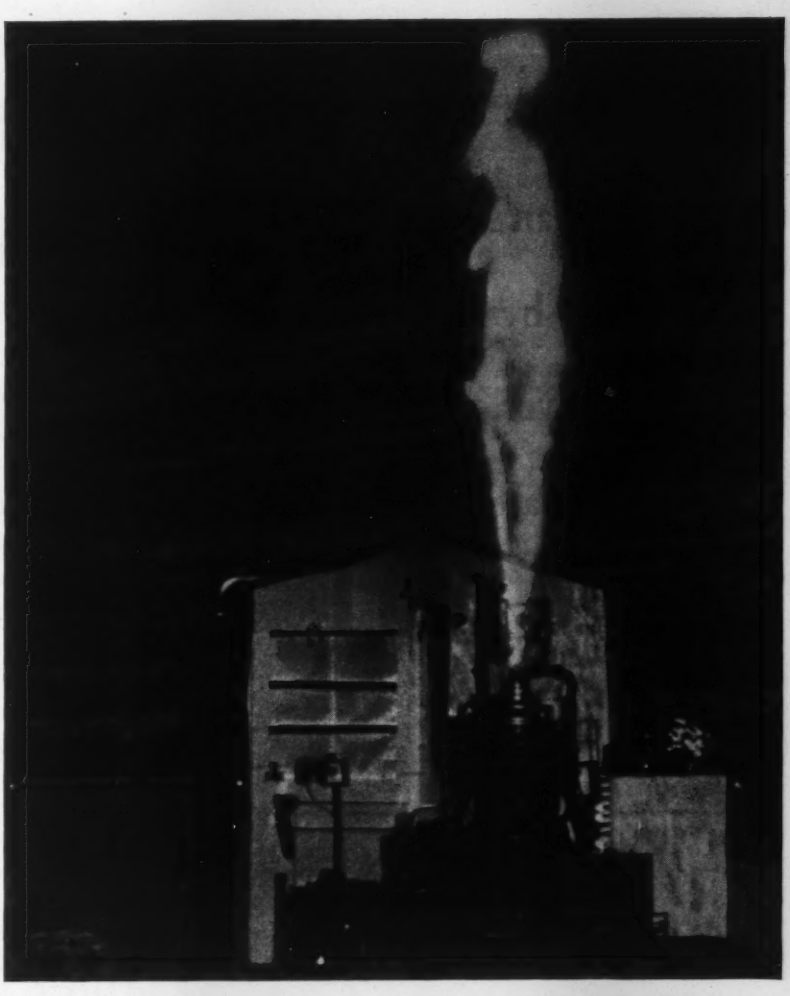

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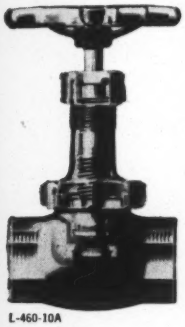

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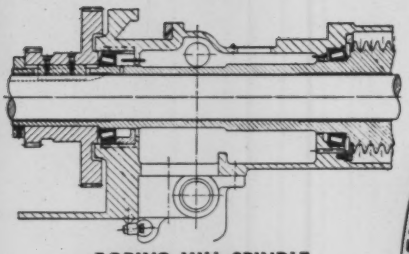

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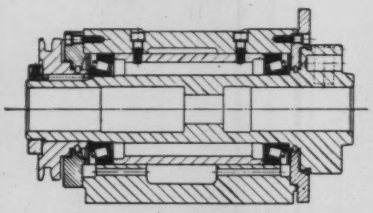

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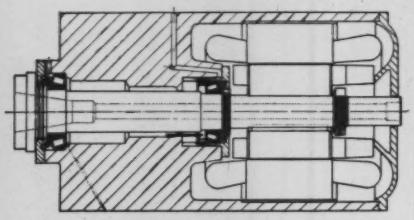

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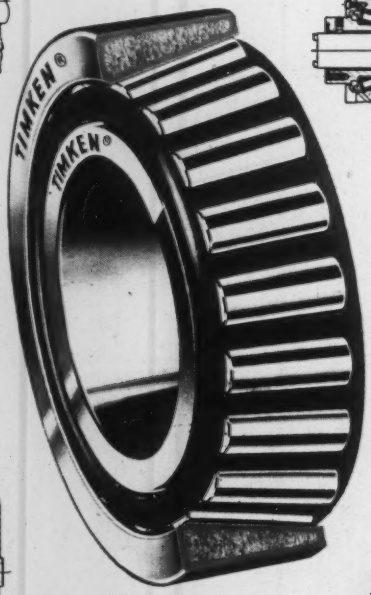
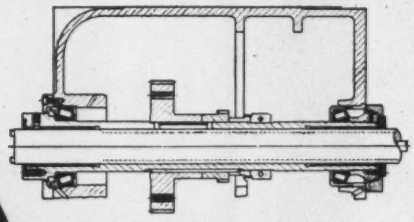


TIMKEN "OO" BEARING



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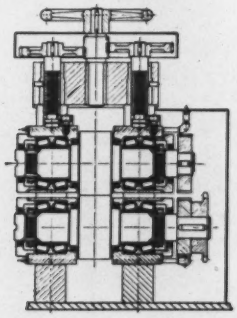

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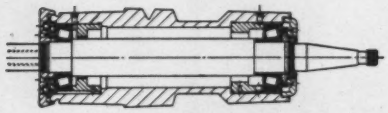

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